A SURVEY OF ANIMAL NEOPLASMS

by

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INTRODUCTION

Neoplasm may be defined as "an abnormal mass of tissue, the growth of which exceeds and is uncoordinated with that of the normal tissues and persists in the same excessive manner after the cessation of the stimuli which evoked the change" (235). Cotchin (40) has succinctly summarised the value of a study of tumors as:

> (1) The immediate importance of the study of tumors is to provide a more exact basis for diagnosis and prognosis;
>
> (2) The study of spontaneous tumors in animals is in any event justified if it will throw any light at all on the general problem of cancer in man in whom it is fast becoming the most common killing disease;
>
> (3) Very little is known about the geographic distribution of cancer in the dog--for example, cancer of tonsil is common in dogs in London and in other places of goiter, cancer of thyroid. Study of larger numbers of tumors from different parts of the world may reveal other differences, which may suggest possible etiological environmental factors that could be brought under experimental study;
>
> (4) The dog being midway between man and laboratory animals in size, might be used for therapeutic trials with great experimental advantage that it could be killed at any stage of the trial. Immunological or other biological work could be done too.

Feldman (61) complained that "one of the greatest obstacles to a proper study of tumors in the lower animals is the lack of statistical data as to the total incidence in the various species of the different types of disease. There is a great wealth of statistical evidence dealing with tumors in man, but veterinary literature is woefully lacking in this regard." Since that time, many workers have studied the incidence of the tumors in animals, but yet these are far from complete or exhaustive. Neoplasms on a geographical basis have yet to be mapped for many regions. It is with such a view to correct the deficiency as far as this area is concerned that the present study and classification was undertaken.

Willis (235) also remarked, "much of the value for human pathologists is yet to be learned from the study of animal neoplasms. More use should be made of the pathological material passing through the hands of veterinarians, breeders and slaughtermen, most of which is wasted."

Feldman's excellent monograph written in 1932, has, so to say, paved the way for studies in neoplasms in all English speaking countries. He has reviewed the work of earlier scientists in his monograph and hence the work prior to 1932 is not reviewed here. Besides, workers from English speaking countries alone are quoted here in this study.

In these studies personal reexamination of nearly half of the tumors (for which slides or blocks were available) was necessitated. In such a procedure, reassessment of some of the tumors was inevitable as well as the diagnosis of a few previously left out and reclassification of others in conformity with the latest system of nomenclature. The tumors of fowl, which by themselves would constitute a detailed study, were not considered here.

MATERIALS AND METHODS

Tumors, whole or in part, were submitted to this laboratory, preserved in 10 per cent formol-saline, from the college clinic, from the packing houses and by the private veterinary practitioners for purposes of diagnosis. A total of 700 tumors were available for study and analysis. At the time of the receipt of these specimens, it was not thought that these would form the subject matter of study at a later date and so complete details as to the sex, breed, and age of the animals affected as well as the location were not maintained. The analysis of 372 tumors were made, based on the information available in the records, and a check on these could not be made as neither

the tissues nor slides were preserved. For the rest of the 328 tumors, slides were available and these were therefore personally studied. But even for these tumors, in the majority of cases, complete details were not maintained and so analysis in respect to age, breed, and site of incidence could not be made.

Sections were stained as a routine measure by haemotoxylin and eosin. Special stains for some of the neoplasms, for which old blocks were available, were used and these are indicated under the appropriate tumors.

Gross descriptions of all the tumors in the hosts is not attempted. A few of the more interesting ones, for which fuller details are available, are described herein.

Cotchin's (43) classification of tumors was adopted in these studies.

TYPES OF TUMORS

Tumors of the Epithelial Tissues

A majority of the neoplasms of the domesticated animals affect epithelial tissues, because of the high proliferative capabilities of this tissue.

Papillomata. "are warty roughened, brush-like papillary structures. They are often horny or spiny to the touch. They contain fibrous cores or projections covered to a variable depth by epithelial cells" (66).

Incidence. Papillomata are fairly common in all animals, but are met with more commonly in young dogs and calves. Among the 700 neoplasms of this study, 21(or 3%) of these tumors were of this type. Of these 21 tumors, eight were found in the dogs, nine in cattle, three in horses and one in a cat. In cattle, the tumors were found in the cornea, skin of teat, pastern, scrotum, penis, foot, heel, oesophagus, and skin of neck.

Microscopically, a typical tumor consisted of a projection of the fibrous core beyond the surrounding tissue, covered over by epithelial cells. Great variation in the thickness of the epithelial layer was noticed. Some of the tumors had well developed keratinised horny covering, giving the tumor a hard feel--the common warts. The fibrous core carried the blood vessels to the tumor. In some the connective tissue moiety was so great as to confuse it with a fibroma.

Comment. Though papillomata may occur singly, often in dogs and calves, these tumors occur in clusters, in the buccal cavity of the former and on the skin of neck and shoulders of the latter. The contagious nature of these tumors in the dog and calves has been proved beyond doubt. The filterable agent in the dog has been studied (155). Experimentally cutaneous warts have been transmitted in a calf (22). Partial immunity by the use of a wart vaccine has been reported in calves (5).

Incidence of papillomata have been reported among canines (40, 41, 88, 103, 166, 205, 235), bovines (32, 52, 76, 103, 144, 181, 185), equines (103, 199, 205) and felines (159, 168).

Tumors of Glandular Epithelium. Theoretically any glandular epithelium can give rise to tumors, but as observed by Feldman (66), a majority of the glandular tumors occur in dogs. Even in this animal some glandular epithelium is more prone for neoplastic growth than others.

Of the 287 epithelial tumors, 77 or 26.9%) were glandular tumors. Among these 77, 70(or 91%) were found in dogs, two mixed parotid tumors in horses, five in cats and two in sheep. In the dogs the mammary tissue and the perianal glands are the most susceptible. In most cases, mammary tumors become malignant ultimately.

Adenoma of Adrenal Cortex. A solitary tumor from a dog was received.

Microscopically, the tumor had a well developed capsule with a great proliferation of the cells of the Zona fasciculata and reticularis. The glomerular layer was much atrophied, only islands of the tissue remaining. The neoplastic cells invaded the medulla, the cells of which were in various stages of degeneration. The neoplastic cells were filled with lipid material and some showed pinkish inclusion bodies. An increase in the fibrous tissue moiety was seen, especially below the glomerular layer, which appeared to encapsulate the tumor. Calcareous deposits were seen in the medulla. Eosinophils were found infiltrating the tissue. No malignancy was noticed.

Mulligan (166) opines that cortical hyperplasia is common in 35 to 65 per cent of old dogs. He found only one adenoma of the adrenal cortex in dogs. Reference to the tumors of adrenal cortex was rare in the literature. Adenomata and carcinomata were reported in limited number among dogs (41, 235). A pheochromocytoma was also reported (89).

Tumors of the Perianal Glands. Seven tumors of the perianal glands from dogs, four of which were benign and the rest malignant, were received. All had subcutaneous location, either lateral to or above the anus.

Microscopically, these tumors did not have well defined capsules, only the skin covering them. Rarely did these tumors have cyst-like cavities. The tumor consisted of solid sheets of epithelial cells, arranged in lobules, which were divided from one another by delicate septa containing blood vessels. The cells were large, polyhedral with faint granular acidophilic cytoplasm, a large rounded nucleus, having a clear fine chromatin and mostly one and rarely two nucleoli. Mitotic figures were not observed. In some parts of the tumor acinar formation was evident. In rare places pearl formation was noticed.

In one specimen, due to surface injury and infection much leucocytic infiltration was observed.

In the malignant forms, the acinar structure was maintained. The neoplastic adenomatous cells showed malignant changes, viz., anaplasia, hyperchromasia and enlargement of nucleus and nucleoli. The reserve cells appeared to be highly proliferated, obscuring the glandular tissue. Abundant blood supply was present. Some of the acini contained necrotic debris. The tissue was separated into lobules by delicate septa, which were infiltrated with round cells.

Tumors of Sweat Glands. Five specimens from dogs consisted of a benign and four malignant tumors. All had subcutaneous locations. Microscopically the cells of the benign tumor were tall columnar mostly, but cuboidal and flat cells were also seen in certain portions. These were arranged in a glandular fashion, many acini having a central lumen, but solid masses of cells also occurred. The cytoplasm of the cells was acidophilic, faintly granular and abundant. The nucleus which was round or oval was almost in the center of the cell, with a finely granular chromatin and small nucleoli. The connective tissue stroma was fairly abundant and showed in places, hyaline changes. Large numbers of blood vessels, lymphocytes and plasm cells were found in the stroma. In some parts the tumor formed cyst-like cavities as in a 'cystadenoma'.

In the malignant variety, the glandular structure described above was maintained but the neoplastic cells showed malignant changes. Numerous mitotic figures were seen. The myoepithelial cells proliferated to an enormous extent. A papillary appearance was sometimes seen due to the projection of the rapidly proliferating neoplastic cells into the lumina of the acini. This picture was not unlike that seen in mammary neoplasms. In some

places the cells assumed a squamous shape. These tumor cells were very invasive.

Tumors of Sebacious Glands. One of the four tumors of the sebacious glands was malignant and arose from the lower eye lid of a cat. The remaining three from dogs were benign. All had subcutaneous locations.

Microscopically, the cells, which were polyhedral had a vacuolated cytoplasm. These were arranged in islands and the cells were clearly demarcated from each other. The nuclei were small, round, centrally placed and had a fine chromatin network. A discrete, well defined, nucleolus was seen. Most of the cells were filled with lipid. The islands of cells were surrounded to a depth of several layers, by elongated oval cells with condensed nuclei--the reserve cells. The islands were grouped into lobules with thick interlobular connective tissue septa. In these septa were found melanoblasts, lymphocytes and plasma cells. The centers of some of the islands showed vacuolation.

The epidermis above the tumor was atrophied and in some places ulcerated. In such ulcerated places bacteria and polymorphonuclear leucocytes were seen. Foam cells around such places were common.

The malignant tumor consisted of short columnar, low cuboidal to polyhedral cells having a faintly granular cytoplasm with indistinct borders and a nucleus like those of the epithelial cells--vesicular. The nuclei were rather large, very dark staining and contained single nucleoli.

These cells were arranged in acinar formation, some with a lumen, but others in sheets. There was an indistinct lobule formation, the septa being made of myoepithelial cells and fine fibrous tissue. The cells in some places appeared frankly squamous. Numerous mitotic figures were seen. Necrosis and hyaline changes were seen in the connective tissue. These

neoplastic cells were highly invasive.

Comment. Tumors of the perianal, sebacious and sweat glands are fairly frequent in occurrence and Feldman (66) remarked that the "sebacious glands of the concha and the perianal glands exhibit a special predilection for this growth." But Jackson (103) found that the tumors of the perianal glands were rare in South Africa. That these glandular tumors are rather common among dogs is borne out by the fact that they are recorded by many authors (40, 41, 88, 103, 143, 164, 166, 205, 235).

Tumors of Intestinal Glands. A total of 11 tumors of the bowel were received. Two were benign and occurred in the rectum of dogs. One of these had a polypoid appearance. Only three of the remaining nine adenocarcinomata, could be examined here; two from dogs and one from a cat. One of the adenocarcinomata of the dogs was from the rectum and recurred twice after surgical extirpation. The other two malignant tumors were found in the course of the intestines.

Microscopically, the benign tumor consisted of columnar epithelial cells arranged as tubules with central lumina in most of the cases. Goblet cells were seen in many such tumor formations. The tubules or alveoli were usually one cell thick and the cells were tall columnar, with acidophilic granular cytoplasm. The nuclei were comparatively large, oval in shape, with fine granular chromatin. Mostly one nucleolus was seen. The nuclei maintained their polarity and were found towards the basement membrane. Some of the cells showed vacuolation of the cytoplasm. The lumina of some of the alveoli contained pinkish granular material. The alveoli were separated by connective tissue septa in which could be seen abundant lymphocytes, plasma cells and thin walled blood vessels.

In the malignant variety, metastases were found in the liver and omentum

in the dog and on to the diaphragm and omentum in the cat.

The history of the cat was that it was a 12 year old animal which was reported to have been ailing for about two weeks. Marked distension of the abdomen with ascitic fluid was noticed. The neoplastic mass involved the omentum and lay along the course of the bowel. It had apparently spread to the abdominal surface of the diaphragm. There was little evidence of spread either to the spleen or liver.

Microscopically, the neoplastic cells which were columnar, were arranged either in a glandular formation or in solid sheets. The cells in some parts were highly anaplastic and showed numerous mitotic figures. Here the cells assumed a squamous and polyhedral shape. The cells were highly invasive and columns and clusters of them were found invading the muscular coat. Goblet cells were seen in sections.

Comment. Tumors of the gastrointestinal tract give rise to digestive disturbances--anorexia, colic, tympanitis and symptoms like obstruction and volvulus. In the later stages, if the involvement is extensive, and if the peritoneum is also affected, oedema of the ventral wall of the body is seen. Involvement of liver results in ascites. Tumors of the gastrointestinal tract have been reported among canines (40, 41, 127, 205, 213, 228), equines (103, 123) and felines (38, 134, 228).

Tumors of Mammary Glands. The mammary glands of the dogs are highly susceptible to tumor formation. Out of the 77 tumors affecting the glandular tissues, 38 were found to arise from the mammary glands.

Only 18 tumors of the dogs and one of the horse could be examined. Among these, two of the dogs were benign, while the rest were malignant.

Classification. Various authors classify the mammary neoplasms differently. For, in this gland, almost any element can assume a neoplastic growth.

The connective tissue, the epithelial tissue of the acini, canaliculi and the ducts as well as the myoepithelial cells can all proliferate singly or as occurring in many tumors, two or three elements at the same time, giving the tumor either a simple or a complex structure as the case may be. The final picture is still more confused by the metaplastic tendencies of the connective tissue and the epithelium into cartilage or bone.

Microscopically, the two benign tumors were of the mixed variety in that they contained tissues of both ectodermal and mesodermal origin. These were designated as cystic papillary adenomata with cartilage.

The tumor cells were high columnar to low cuboidal with an acidophilic granular cytoplasm and a vesicular nucleus, which was oval to rounded. The polarity of the cells was maintained. In some, squamous metaplasia was noted. The epithelial cells projected into cyst-like formations as papillary buds, with a core of fibrous tissue. The cysts sometimes contained pinkish material. The myoepithelial cells had also proliferated giving the tumor a very cellular appearance in such parts. Metaplasia of the fibrous tissue into cartilage in some portions was noticed. In other parts necrosis, infection and attendant leucocytic infiltration were also observed.

Many of the malignant tumors metastasize into the internal organs. One case of such widespread metastasis is described under: A 30 pound black, nine year old cocker spanniel was presented for treatment with indefinite symptoms of listlessness and loss of appetite. A tumor was found on the left shoulder near the shoulder joint. The tumor was of the size 2 1/2 × 3 × 3 cms. Metastasis from the mammary glands was suspected after considering the previous history, which was that the bitch had been spayed at about six years of age, i.e., three years previously. Two years later, at the age of eight years, she developed tumor masses on the second right anterior breast and the

third anterior left breast which had attained the size of 3 × 5 × 2 cms., and 4 × 3 × 3 cms. respectively, and were removed intact surgically and diagnosed as papillary adenocarcinoma, grade 4.

The dog was sent home but came back later for euthanasia. On necropsy, a mass 4 × 2 × 3 cms. was found in the subscapular region and numerous masses from pin-point to 3 cms. in diameter were found in the lungs. Two small masses were found in the liver and two in the kidneys. The adrenal glands were engrossed with rounded tumors from 2 to 4 cms. in diameter. On the left side two distinct masses were found. No tumors had reappeared in the mammary glands.

Among the malignant tumors examined, only three were of the simple variety, viz., lobular, duct and myoepithelial. The rest were of the mixed variety, i.e., containing the elements of acini, ducts and myoepithelial cells in various proportions.

In the mixed variety, the duct epithelium was usually arranged in a papillary manner, some cystic, while the acinar epithelium was arranged in a more solid manner into lobules. The cells which were columnar or low cuboidal, showed characteristics of malignancy, viz., polyhedral to rounded shape, hyperchromatic nuclei and larger nucleoli, loss of polarity and large numbers of mitotic figures and anaplasia. Metaplasia toward squamous variety was observed and this was true even in the metastasis into lungs in one of the cases.

The myoepithelial cells, which consisted of spindle shaped cells with tapering ends, also proliferated, some in malignant proportions. These cells had relatively scanty cytoplasm and oval nuclei with small nucleoli.

The connective tissue, which was hyperplastic showed hyaline changes and metaplasia into cartilage and in one instance myxomatous degeneration was

seen. Numerous thin walled blood vessels were seen in the connective tissue. In some parts frank haemorrhage was observed. Ulceration of the superficial skin resulted in infection and accompanying leucocytic response.

These tumors were designated as adenocarcinomata, as suggested by Bloom (18), with or without cartilage formation depending on the presence or absence of cartilage.

In the simple duct carcinoma, the cells were arranged either in acinar or multiacinar formation, but some times in solid sheets also. More commonly, a papillary arrangement was noticed wherein the cells were one to several layers thick. The fibrous tissue core was delicate and contained the blood vessels.

In the lobular carcinoma, the acinar cells were arranged mostly in sheets or in small acini with lumina inside. Some designate this the true adenocarcinoma. Here the fibrous tissue may be so great as to give the tumor a fibrosed appearance and so it may also be called scirrhous adenocarcinoma.

In the malignant myoepithelial-cell carcinoma, the cells were very much enlarged and assumed a polyhedral or rounded shape. The nuclei were ballooned with larger nucleoli. Numerous mitotic figures, some showing atypical mitotis were seen. Tumor giant cells were common in this tumor. The fibrous tissue around these cells appeared to be incited to multiply and metaplastic change into cartilage or bone was seen.

Metastasis was observed into the lungs in one case and into lungs, liver, kidneys and adrenals in two others. In the first the tumor was of the duct adenocarcinoma variety, the cells being arranged in solid sheets with numerous mitotic figures. Cystic spaces formed by these cells were also seen. The tumor was found as a 'nodule' with a definite capsule. The surrounding pulmonary tissue showed emphysema.

A second metastasising tumor was the myoepithelial-cell variety. The last was a cystic duct papillary adenocarcinoma.

In the horse, one malignant mammary tumor was found with metastases into the thoracic cavity. The cells were arranged in most places as solid sheets with rarely ineffectual attempts at acinar formation. The cells were low columnar but were so anaplastic as to appear polyhedral and squamous. The cytoplasm was acidophilic and granular with a large vesicular nucleus having chromatin in clumps. The myoepithelial cells were active, proliferating to some extent, but showing no malignancy. The tumor was divided into lobules by connective tissue septa, which in some places was very abundant. Large areas of necrosis were observed. In the metastasis found near the aorta, the above picture was repeated. Here there was great infiltration by lymphocytes.

Comment. Almost every one who has studied canine neoplasms has recorded the incidence of this tumor as the most common among the canines.

Among the excellent reviews on the subject could be mentioned those of Allen (1), Bloom (18), Cotchin (44), Moulton (160) and Mulligan (166) among dogs and that of Nielson (171) among cats. MacClelland (142) described fully some neoplasms of the canine mammary gland. Elder et al., (58) have described an adenocarcinoma in a heifer.

Incidence of metastasis in mammary tumors appear to differ in different places, for Cotchin (44) found it in only 10 per cent of his cases, while Bloom (18) found it in 25 per cent of his cases and Krook (126) found it in 50 per cent of the cases he examined.

Cotchin (44) has, after microscopical and histochemical studies, concluded that the myoepithelial cells are the interposed cells, lying between the basement membrane and the acinar epithelium.

Schlotthauer (212) after careful dissection and study of lymphatic drainage has found that the tumors affecting the anterior three pairs of glands first metastasize to the axillary lymph node while the posterior two pairs to the inguinal nodes.

There does not appear to be unanimity in the histogenesis of cartilage and bone in these tumors. Moulton (160) and Mulligan (166) contend that the cartilage develops from neoplastic glandular epithelium. Bloom (18), Jackson (103) and Willis (235) are of the view that chondrogenesis is of connective tissue in origin. Allen (1) declares that the cartilage appears to be derived directly from adult epithelium.

In these glands the mesoblastic tissue may become sarcomatous. If in such tumors both mesoblastic and epiblastic tissues are present in malignant proportions, the name 'mixed tumor' is applied by Jackson (103) and Mulligan (166). But Cotchin (44) prefers to call them 'complex tumors'. Allen (1) does not favour 'mixed tumor' but prefers to add the words 'myxo' or 'chondro' or 'osteo-fibro-sarcoma', whenever these are present. In the material under review here, such sarcomatous tumors were not found. Nor has the 'carcino-sarcoma', mentioned by Jackson (103) and Bloom (18) seen here. The myoepithelial-cell tumor described here may probably come very near to this type.

Bloom (18) mentions that the etiological factors for the development of mammary tumors in dogs are related to heredity, hormonal (estrogenic) in-balance and abnormalities of lactation. Cotchin (44) observes, "since the myoepithelium appears to play a significant role in a large proportion of mammary neoplasms of the bitch, a study of the stimulus, presumably hormonal, which causes normal growth of this type of cell is indicated."

Tumors of Prostate. Two malignant neoplasms of the prostate were observed in dogs. In one, mestastases were found in the kidney and liver.

In the other no metastasis was found but a mass of tumor of the gland pressing on the rectum and occluding it was noticed.

Microscopically, the tumors had an adenocarcinomatous appearance, the acini being lined by columnar cells having a vesicular nucleus. Polarity was lost, the cells being disarranged. Numerous mitotic figures were seen. The cells were usually one layer thick. Sometimes the cells projected into the lumen as papilliform arrangement. In some places cystic formation was observed. Many cells showed degenerative changes. The stroma was scanty with rich blood supply. In the metastases, which were nodular, a thin capsule was found and the glandular structure was reproduced in the neoplastic mass.

Comment. Tumors of the prostate gland have been described by different workers, (18, 40, 41, 103, 196, 214, 219, 235). These tumors are usually seen in dogs over 10 years of age and Bloom (18) observes that he had never seen one in a castrated dog.

The relationship between castration and the size and activity of these glands is discussed by Schlotthauer (210), who found that 60 per cent of dogs not castrated had lesions in their prostates. Testes are essential for the growth of prostates. Inbalance of androgens and estrogen may be of etiological significance.

Tumors of Pancreas. Three tumors of the pancreas were observed in old dogs, with metastasis to the internal organs. All the three were of exocrine glandular in origin.

One of the cases had the following history: The subject was a 12 year old female dog. There was a history of chronic cough for the previous one year. X-ray revealed a mottled appearance of the thorax. There was emaciation, anorexia and swelling on the ventral thorax. There were neoplastic

nodules in the lung and spleen with the largest in the pancreas. Oedema of the ventral part of the thorax, interstitial nephritis and adhesion of the bladder to the large intestines were noticed.

In another case metastasis was found in the liver only, while in the third metastases were found in the duodenal wall and hepatic lymph nodes.

Microscopically, the neoplasm was an adenocarcinoma. The cells making up the acini were low cuboidal, columnar or even polyhedral with round, elongated or oval nucleii. The cytoplasm was finely granular. Where polarity was maintained, the nucleii were located towards the basement membrane in the cells away from the luminal side. The nucleii were vesicular with coarse chromatin. Numerous mitoses were seen. Haemorrhages were found in some places. Blood supply was plentiful and stroma delicate.

This same architecture was also maintained in the metastases. The cells in some parts were squamous. Tumor emboli in vessels were found.

Comment. Tumors of the pancreas are not so frequent as is evident by paucity of literature on this subject. A few workers have reported carcinoma of the pancreas in canines (40, 41, 235), felines (38, 235) and ovines (103). An interesting tumor of the islet cells with hyperinsulinism was reported by Slye and Wells (220).

Tumors of Thyroid. Adenomata of thyroid in horses is not uncommon. Jackson (103) quotes Schlotthauer as having observed it in 37 per cent of cases. One malignant tumor from a horse is described here.

Microscopically, the tumor consisted of alveoli filled with colloid. In many other parts the neoplasm was more solid. The type cell was a columnar epithelial cell with acidophilic granular cytoplasm and an oval vesicular nucleus with fine chromatin. The polarity was maintained in those arranged as alveoli. In the solid portions, where the cells were in solid masses,

the cells were more anaplastic with loss of polarity. Mitotic figures were seen frequently. Connective tissue stroma was scanty. In some places, haemorrhage was seen.

Comment. Tumors of the thyroid have a geographic distribution, having higher incidence in goiterogenic areas. Kansas being non-goiterogenic, incidence of thyroid tumors in this state is low. Willis (235) has found adenocarcinoma of the thyroid in a dog and a horse. Jackson (103) found adenomata in five equines and 10 ovines, while Krook (126) found it in 98 canines.

Tumors of the Lung. Primary carcinomata of the lung have been reported in different animals (156), but yet, this tumor is considered to be one of the rarer neoplasms (103). Three primary pulmonary adenocarcinomata received from a dog, cow and a cat were examined out of the four received in this laboratory.

The bovine case was a lung received from a packing house and was suspected for actinobacillosis.

Microscopically, the neoplasm consisted of columnar cells arranged as tubules mostly and more solidly in other parts. The cells were tall columnar to cuboidal, with an acidophilic granular cytoplasm and a vesicular nucleus with fine chromatin. The nucleus was either flat and elongated or rounded. In some places it was pyknotic. Mitotic figures were seen frequently. In some places the cells were arranged in vertical columns of one cell thick, two such layers being separated by fine stroma.

The alveoli of the lung were filled with the neoplastic cells (cancer pneumonia) which assumed a more polyhedral or rounded shape and sometimes even squamous. Frank metaplasia to squamous variety were not seen but parakeratin pearls were found in the feline tumor. Prickles could not be demonstrated here.

Peribronchial lymph vessels contained tumor emboli and these tumors were of the infiltrating type.

The stroma varied considerably in the same tumor. In some places thick bands of connective tissue divided the tumor into lobules. In some the stroma divided the neoplastic growth into islands. Abundant thin-walled blood vessels were present.

In two of the tumors, viz., the bovine and canine, infection was evident with leucocytic infiltration. Much necrosis followed by calcification was noticed in the tumor from the cat. Haemorrhages were found especially in the periphery of the tumors.

Comment. These neoplasms were considered to be bronchiogenic and were designated as adenocarcinomata. It cannot be, with certainity, declared if the cells arose from the bronchial glands or the lining epithelium. The sure test for the former is the demonstration of mucin in the cells (103). But it is well known that the epithelium under pathological conditions, is quite capable of changing from one cell-type to another. Based on the arrangement of the cells, the neoplasms were therefore considered to be adenocarcinomata. To avoid such difficulties Monlux (156) classified the neoplasms, according to microscopic anatomical appearances as squamous cell, columnar cell, mixed cell and undifferentiated.

Primary lung tumors were reported from canines (41, 68, 103, 126, 195, 235), bovines (116, 181, 207) and ovines (53, 103). Recently Monlux (156) has reviewed 155 cases of primary pulmonary neoplasms occurring in canines, equines, bovines, felines, ovines and miscellaneous animals.

Tumors of the Liver. It is frequently recorded that the specialised epithelial cells of the parenchyma of the liver often gives rise to carcinoma Feldman (66), Jackson (103), Willis (235). Jackson goes further and

observes that "considering the domestic mammals as a whole, primary liver tumors are among the most frequent of internal epithelial neoplasms." In the collection under report, seven carcinoma hepatocellulare were encountered, of which three were from dogs, three from bovines and one from a pig. One metastasising case of carcinoma cholangic-cellulare was also found in a bovine. Of the liver-cell tumors, one from the dog and all from the bovines showed metastases into various organs. Two cases, one from a dog and another from a cow are described here:

(1) The subject was a Hereford cow, about three years old. She came to the clinic with a history of recurring tympanites. The owner had administered magnesium sulphate. There were no obvious gross lesions in the head. There was some fibrinous pleuritis of the parietal pleura. There was much thickening of the mediastinal tissues with fluid and fibrin. The lymph nodes were considerably enlarged, swollen and appeared somewhat necrotic with yellow granules. The lungs failed to collapse completely. There were areas of consolidation which contained little air. There were numerous pale masses uniformly distributed through the lung. The borders were sharply circumscribed. The size was variable up to 12 inches in diameter. The liver likewise revealed quite a number of similar nodules. Nothing abnormal was seen in the spleen. One pale area of infarction was seen in the kidney.

(2) The subject was a seven year old female English greyhound, weighing about 75 lbs. in fair flesh although quite anemic. It was icteric. There was no ascites but some free blood in the abdominal cavity and omentum. The liver was enlarged to perhaps one and one half times its normal size. It was soft and some of the neoplastic masses had ruptured. There were numerous masses or nodules up to 2 inches in diameter in the liver. They stood up above the surface. Some of the nodules were necrotic. A small mass in the

pancreas with a number in the omentum and peritoneum was also seen. A lymph gland adjacent to the cecum 1/2 inch across appeared neoplastic. There was catarrhal enteritis. The lungs, reproductive tract, heart and mammary gland appeared normal.

Microscopically, the liver cell tumors were usually encapsulated and more often demarcated from the normal tissue, though at some points there was intermingling with the normal hepatic tissue.

The neoplastic cells which bore a close resemblance with their parent cells, were usually arranged in sheets or in columns. These cells were large, rounded to polyhedral, with acidophilic cytoplasm, which was granular (sometimes the cytoplasm was also very pale staining). The nucleus was very large, usually amblychromatic and occupied a central position. The n:N ratio was very narrow. Mitotic figures were numerous (as in the canine case) or few. In some places giant cells with bilobed nuclei were seen.

A fine stroma was present. One noteworthy feature was the presence of a large number of thin walled blood vessels, with which the tumor cells had a close association. Tumor emboli in the blood vessels were seen and accounted for the metastases. In some parts thick trabeculae of vascular fibrous tissue divided the tumor into lobules. No bile ducts or portal triads were reproduced in the neoplastic overgrowth.

In the metastases also, the same description as above was reproduced.

The adjacent healthy parenchyma of the liver showed various stages of degeneration and in some cases, cirrhosis.

The cholangiocellular carcinoma was obtained from a seven year old Hereford cow, which appeared to be in good condition. She died after an abortion. On necropsy, a few small neoplastic nodules were found in the lungs, up to 3/8 inch, which were palpable. Peritoneal cavity contained a

considerable quantity of clear yellow fluid. Much of the peritoneal surface was diffusely thickened with numerous small nodules. Liver was considerably enlarged, lobulated, somewhat reddish-orange in color and had pale streaks on the surface.

Microscopically, the liver showed large areas where the parenchyma was replaced by the neoplasm. The neoplasm consisted of tubules of newly formed bile ducts, with considerable collagenous tissue. What was left of the liver parenchyma was fatty.

The tumor cells were of two types, depending upon the anaplasia seen. In one area the typical cell resembled the bile duct epithelium, but with a more condensed and hyperchromatic nucleus. The size of the cell, which was low cuboidal to flat, was larger. The cytoplasm was faintly granular. Well developed enlarged nucleoli were seen. In other parts, the cells appeared to line large cyst-like places, which appeared to be filled with a solid mass of neoplastic cells. In still other places the content of the tubules was blood, which completely filled out the cavity and appeared to be in free circulation. Here the lining cells were flattened with elongated oval or spindle nuclei whose nucleoli were inconspicuous and whose membrane was delicate. Morphologically these resembled endothelial cells and these areas could be mistaken for haemangio-endothelioma. In some other places the cells were disposed of in thin elongated cords in a thick connective tissue stroma. Papilliform ingrowths of the cells into the lumina of the tubules were not rare. Sometimes these cells were so anaplastic that it was difficult to recognise their identity. Mitotic figures were frequent. The neoplastic cells were free from pigment. But numerous macrophages loaded with pigment were seen strewn in the stroma.

In the lungs, tubules were seen, but with less differentiation. Tumor

emboli of veins could be seen. In this place the 'nodules' were encapsulated by a thin fibrous capsule. Here also the papilliform structure noted in the liver was noticed.

Comment. These tumors are sometimes designated as 'hepatomas' or 'malignant adenomas', which is not correct as it denotes a trial at escapism from the onus of correct diagnosis of the tumor. True it is that there may be, sometimes, difficulty in distinguishing primary hepatic parenchymatous-cell carcinoma from cholangiocellular carcinoma. But a little careful examination will surely elucidate the exact nature. The following differences are noted among the two types of the tumors:

Cholangiocellular	Hepatolellular
1. Grossly yellowish white in color.	1. Whitish to redish.
2. No encapsulation.	2. Usually encapsulated.
3. Early metastasis into lymph nodes-lymphatic metastasis.	3. Metastasis into parenchyma and lungs-haematogenous metastasis.
4. Cells columnar and characteristically bile duct.	4. Cells polyhedral and resemble hepatic cord cells.
5. Usually lumina formed.	5. No lumina formed.
6. Nucleus located proximally in the cells.	6. Nucleus central.
7. Collagenous stroma great.	7. Collagenous stroma not so great.
8. Cells have no close association with blood vessels.	8. Cells have close association with blood vessels.

Nodular hyperplasia is rather frequent, especially in older animals. Mulligan (166) observes that it is present in 15 to 60 per cent of old dogs. This condition may pose a difficulty in distinguishing them from carcinoma. The following microscopic differences help in such diagnosis. The cytoplasm

of the cells of the non-malignant tumor resembles that of the liver cells in staining reaction while in the carcinomas there is an inconstant tendency to basophilia. The nuclei although distinctly enlarged are more uniform in size than in most of the carcinomata. Nucleoli do not show enlargement in proportion to nuclei in the benign form, mitotic figures are absent while in the malignant mitotic figures are always seen.

In canines (40, 41, 126, 165, 234, 235), bovines (32, 64, 116, 124, 181, 182) and ovines (209) these tumors of the liver have been reported. Jackson (103) has given a good description of hepatic neoplasms in dogs, cattle, pigs, and sheep.

Transitional-cell Carcinoma. One specimen was received for which the following history is available: The subject was a 15 year old gelding. The horse was observed to be having some difficulty in breathing when ridden. It was in the hospital for two weeks. On examination a marked swelling of the region of the pharynx and larynx was apparent. The hyoid bones and the larynx were markedly depressed ventrally. It was impossible to reach and palpate the larynx through the mouth. An unfavourable prognosis was given and so the horse was destroyed. On necropsy, the pharynx, larynx and the upper portion of the trachea were fairly surrounded by a layer of fairly firm grey neoplastic tissue. The mass attained its maximum thickness dorsally where it was about 5 inches and on the right side where it was 3 to 4 inches in thickness. The tumor mass lay between the pharynx and the floor of the cranial cavity. It seemed to have infiltrated the base of the tongue, with some erosion of the base of the pharynx and considerable necrosis of the laryngeal mucosa. The pressure of the tumor had produced some lateral distortion of the larynx although the oesophagus and pharynx were not occluded.

Microscopically, the neoplastic tissue was seen to consist of variable

amounts of connective tissue stroma, which was often very abundant and very cellular, supporting strands of epithelial cells. Some of these strands had lumina. The cells were low cuboidal, sometimes low columnar, but in most places polyhedral. The polarity, though maintained in some places, was lost mostly. The nuclei were large, vesicular but in some places very condensed. Nucleoli were usually multiple, two to three being frequent. Mitoses were frequent. In other parts of the tumor, especially at the edge where it grew into the bone, the cells were more solid and compact. Osteoclasts were abundant as well as the connective tissue which had assumed malignant proportions, so that it could be taken for a fibrosarcoma. Emboli of tumor cells were found in blood vessels. In some parts the cells were frankly squamous, some showing keratinisation. There was great infiltration by lymphocytes, which were so many as to lead to the term lympho-epithelioma of some authors.

Comment. This was called a transitional carcinoma because it was a malignant tumor intermediate in character between glandular carcinoma and squamous-cell carcinoma. Such tumors have been reported in man in the pharyngeal region and is supposed to be a highly anaplastic epidermoid carcinoma. Evidently this tumor under report had arisen from the pharyngeal mucosa. The lymphocytes present here did not constitute part of the tumor proper but were secondary cells normally present in the pharynx and throat.

Jackson (103) has described four such transitional carcinomata in the bovines, two arising from the nasopharynx and two from the ethmoidal mucosa.

Thymomata. One tumor was received, which was found in a five year old horse. The neoplasm which was about 12 to 14 inches by 10 inches filled the anterior part of the thoracic cavity anterior to the heart.

Microscopically, the tumor consisted of two types of cells primarily.

(i) Cells epithelial in character, had a poorly defined but extensive

faintly eosinophilic cytoplasm, and a large oval or irregularly oval, extremely amblychromatic nucleus. The nuclear membrane was poorly developed. The chromatin network of the nuclei was very delicate. Nucleoli were small. The cells had long processes forming a reticulum in the meshes of which were found the second type of cell described below. In some places, these epithelial cells appeared to form compact bodies simulating Hassal's corpuscles.

(ii) The second type of cell resembled in all respects the small lymphocyte. These were found intermingled with the epithelial reticular cells and in some parts arranged into small 'nodules'. The tumor was supplied by a generous blood supply. Mitosis was rare.

Comment. This tumor was diagnosed as thymoma due to the following reasons:

(i) the location--thymomata being situated in the anterior thoracic cavity;

(ii) though reticulum cell sarcoma might have suggested itself, the two types of cells involved and the cells not associating themselves with the fibrillar reticulum ruled out such a possibility;

(iii) this tumor satisfied all the criteria enunciated by Jackson (103) and fitted in closely to his description and;

(iv) the question of a heart base tumor was ruled out because: (a) the cells did not fit in the description of the cells of a heart base tumor, (b) no giant cells were noticed and (c) the presence of two types of cells was against any consideration of its being a heart base tumor and finally (d) heart base tumors (aortic body tumors) have not been described in any other animals except dogs (though of course a theoretical possibility of its occurrence in other species was born in mind).

As observed by Jackson (103), thymoma are very rare tumors. He has de-

scribed seven tumors, four from bovines, two from ovines and one from a caprine. Leeper (133) described a walnut sized thymoma from a dog and Locke (137) recorded one from a cat.

This is probably the third of its kind described in the horse.

Granulosa-cell Tumor. Tumors arising from the follicular epithelium of the ovary are noticed in different animals. In this collection, a granulosa-cell tumor was received from a heifer that was slaughtered at a local plant. The history of the animal was: the subject, a two year old heifer, had never freshened and yet the development of udder was sufficient to have been in milk. No other gross lesions were noticed. The body, one horn and the uterus and the corresponding ovary were normal. The left ovary was a rounded mass approximately 10 × 16 × 19 cms.

Microscopically, the tumor was well capsulated and consisted of islands of granulosa-cells in a thick fibrous tissue stroma. In some areas, the cells had a folliculoid appearance. The cells were rounded but were columnar in places, with granular acidophilic cytoplasm and a rounded vesicular nucleus with stippled chromatin. These cells appeared to be arranged in clusters or alveoli with well defined basement membrane. In some places the center of such alveoli contained pinkish material. In certain areas Call-Exner bodies or rosettes were found, which were formed by more spindle shaped cells. Mitosis was frequent.

Comment. Granulosa-cells have the capacities of hormone production and in a majority of the tumors hyperoestrinism is observed. There may be nymphomania as observed in a cow by Kingman and Davis (120) and in a heifer by Langham and Clark (132). In some animals hyperplasia of the genital system may be observed. Besides the authors mentioned above, DaCorso (47) found a granulosa-cell tumor and an arrhenoblastoma in cows. Roberts (194) described

a granulosa-cell tumor in a heifer. Howard (97) described a five lb. tumor in a seven year old mare.

Testicular Tumors. Seminomata. Two specimens were received. These were found in the testes of mature dogs.

Microscopically, the tumors consisted of solid sheets of neoplastic cells which were arranged in small lobules separated by thin strands of connective tissue. The cells which were mostly anaplastic, were rounded, sometimes polyhedral, having a granular acidophilic cytoplasm. The nucleus which was rounded or ovoid, was very large with coarse chromatin and a definite nuclear membrane and one or two nucleoli. Thin walled blood vessels were noticed in large numbers. There were no vacuoles in the cytoplasm, contrasting the cells from the Sertoli-cells and the Leydig-cells. Mitosis was very frequent.

Sertoli-cell Tumor (Sustentacular cell Carcinoma). Two specimens were received, in one of which, matastasis was present in the perineal region.

Microscopically, the cells were found in adenomatous formation, i.e., in alveoli. The cells were spindle shaped with usually a clear cytoplasm and an oval or oblong nucleus. It was not uncommon to see polyhedral cells with rounded nuclei. Such cells were more undifferentiated. These neoplastic cells had a characteristic pallisade arrangement and contained large amounts of fat.

Comment. The seminoma arises from the germinal epithelium of the seminiferous tubules while the Sertoli-cell tumor, as its name implies, from the Sertoli cells, and is believed to be feminizing by liberating oestrogens. Clinically, the affected dog showed loss of libido, gynecomastia, penile atrophy, attraction of other male dogs, obesity and lethargy. Brodey and Martin (29) found elevated estrogen content of the urine in dogs with the

Sertoli-cell tumors. After surgical removal of the neoplasms the urinary estrogen levels dropped to normal. Daykin and Smythe (56) found that intramuscular injection of chorionic gonadotrophin decreased gynecomastia and increased the size of the penis in a dog with this tumor.

Seminomata are not invested with estrogen formation.

Of the three types of the primary testicular neoplasms, the Leydig-cell tumor was not represented in the collection reported here. Hooker et al., (96) found a higher content of Leydig-cells in older dogs in which the incidence of the Leydig-cell tumors was higher than in the young.

Testicular tumors among dogs have been reported by many authors (21, 27, 29, 34, 40, 41, 95, 98, 100, 112, 114, 166, 217, 234 and 235). Smith (221) has reported an interstitial-cell tumor in a horse, and Mier (150) found a Sertoli-cell tumor in a cat.

Basal-cell Carcinomata. Of the seven neoplasms received under this category, three were found in the canine, one in an equine and the other three in felines. Only three specimens were examined. All had subcutaneous location.

Microscopically, the tumor consisted of strands of cells, mostly in long columns, which on cross section gave an alveolar type of arrangement. The connective tissue around the 'adenoid' structure was rather plentiful and sometimes to the extent of making the tumor of a scirrhous type.

The cells were flat and polyhedral with a faint bluish cytoplasm and a cigar-shaped elongated nucleus, with fine chromatin and usually solitary nucleoli. Mitotic figures were frequent.

In some places parakeratin pearls were found and in others mimicry towards hair follicle arrangement was noticed. In none of the tumors examined could prickle cells be found. In some fields the cells had a very compact type of arrangement.

Comment. There appears to be no unanimity in the conception of histogenesis of basal cells. One school of thought to which Jackson (103) appears to lean, claims that the cells are derived from the basal layer of the stratum germinativum. The other school to which belong Mulligan (166) and Foot (72) declares that the cells are derived from the undifferentiated epithelial cells of the matrix from which hair normally develops. Willis (235) remarks that "this type of growth may arise in the epidermis itself--or it may arise not from the epidermis but from pilosebacious follicles or sweat glands deep in the dermis." He, therefore, describes the neoplasms under two categories--those of superficial origin and those of the subepidermal origin. One characteristic that some bear great weight is the absence of 'prickle cells' in these tumors. For a tumor to be truly basal, no prickle cells should be found. But Mulligan (166) describes prickle cells in these tumors.

Basal cell carcinomata have been reported in canines (41, 88, 103, 166, 182, 205, 234), equines (103, 205) and felines (38, 88, 168, 235).

Adamantinomata. This is the commonest of the dentigerous group of neoplasms and represents blighted or distorted development of embryonal enamel organs. The mandible is the most commonly involved in this tumor. Adamantinoma may arise from any site adjoining teeth.

Four Adamantinomata, three from dogs and one from a mule, were represented in this collection. The sites of origin were:

Dogs: in the lower jaw; second and third canine teeth; upper canine tooth.

Mule: mandible (of an old mule).

The history of one of the dogs was as follows: the subject, a 12-year old male dog in which the upper lip was first observed to be protruding about a month prior to the visit to the clinic. A solitary firm tumor-like mass

had been growing outwards from the periosteum of the maxilla in the region of the upper right second and third canine teeth. Necropsy revealed nothing further except a hematoma of the spleen.

Microscopically, the tumor cells were arranged in cysts or solid masses. The type cell was the embryonic enamel epithelium, which was characteristic. It was columnar, more fusiform like, with a faint basophil cytoplasm and an elliptical nucleus having a fine chromatin and a single nucleolus. The cells were so arranged as to give a serrated edge on the external side of the cysts. The cysts were either empty or contained, occasionally, necrotic debris. These cysts appeared to be studded in a dense vascular connective tissue. In some cysts, appearance of a stroma inside the lumina was characteristic and pathognomonic (72). Mitotic figures were few.

In the solid variety could be found a squamous type of cell and rarely parakeratin pearls.

Comment. Though the tumor cells resemble ameloblasts, they do not produce enamel. Hence Willis (235) doubts if the name adamantinoma to this type of tumor is at all apt.

This tumor is of very low malignancy, spread occurring locally by extension.

Very few adamantinomata have been reported in the literature. Cotchin (43) quotes continental authors that have reported these tumors in animals. The few that were reported were from cattle. Cotchin himself has seen only two in cattle. Among bovines Chandrasekharan Nair and Sastry (32) reported this type of neoplasm among 14 dentigerous tumors and Jasper and Kanegis (107) described one.

Squamous-cell Carcinomata. One hundred fifty six squamous-cell carcinomata (i.e., 62.4 per cent of all malignant epithelial tumors and

22.7 per cent of the total number of neoplasms) were received.

The number received and the sites of occurrence for which data are available are shown in Table 1.

Table 1. Total number received and the sites of origin of the squamous-cell carcinomata among different species.

Species	Number received	Location	Number
Canine	40	Prepuce	1
		Skin from abdomen	1
		Skin around anus	3
		Skin of tail	1
		Toe	1
		Tonsil	1
		Buccal mucosa	1
		Tongue	1
		Ear	2
		Eye	2
		Trachea and pharynx	1
		Metastasis in lung	1
Bovine	76	Eye	58
		Metastasis in lungs from eye	3
		Skin of ear	2
		Vulva	8
		Sinuses of head	1
		Horn	2
		Vagina	1
		Nerve	1
Equine	38	Frontal sinus	3
		Eye	19
		Vulva	3
		Penis	4
		Lymph gland	2
		Sphincter ani	1
		Hip region	1
		Teeth	1
		Prepuce	3
		Legs	1
Porcine	1	----	----
Ovine	1	Above the eye	1
Total	156*		

* Of the tumors received, only 46 could be examined and studied.

The tumors of the frontal and maxillary sinuses are very interesting and so the history and details of one case is described here.

The animal was a 16 year old gelding and was an outstanding performer as a saddle horse. Six months earlier, it was noticed to have a slight nasal discharge on the right side. Four months later, the condition became bilateral. About that time an exophthalmus began to appear on the right eye. Blindness developed in that eye and in two months time the horse was totally blind. An unsuccessful attempt was made to pass a stomach tube and for some days the horse had had difficulty in respiration. It was therefore destroyed.

On necropsy, an irregular shaped mass 1 1/2 by 2 inches, was secured while removing the tongue from the soft palate. The posterior nares was practically occluded with an irregular shaped mass of neoplastic tissue. The anterior part of the maxillary sinus in front of the right eye was well filled with irregular masses of neoplastic tissue. It extended under the orbit but did not entirely fill the sinus. The tumor mass completely filled the posterior part of the upper air passages on the right side. The right frontal sinus was completely filled with the tumor mass. It extended through the posterior nares to the left side where there was still a small opening for the passage of air. The neoplasm surrounded the right optic nerve and had eroded the floor of the cranial cavity but no gross lesions were seen in the brain substance or on the dura.

Microscopically, the stratified squamous epithelium of the skin, mouth, pharynx, rumen or vulva showed thickening, papillary folding and acanthosis with elongation and broadening of the rete pegs. From this epithelium emanated the neoplastic tissue, which was found as diffuse collections or compact masses of squamous epithelial cells, which were incompletely divided

into nest-like groups or strand-like processes, invading the adjacent healthy tissue. The blood supply for the tumor was by numerous thin walled blood vessels found in the stroma, which was plentiful. The epithelial cells varied widely in appearance in different parts of the same tumor. Mostly, the cells were polyhedral with prickle borders and large nuclei which also varied considerably in size and shape. The nuclei were amblychromatic and had two large nucleoli. Mitotic figures were numerous and sometimes bizarre.

Cell nests or pearls were common in this tumor and was pathognomonic for this neoplasm.

Along the margins of the invading carcinoma was seen infiltration of lymphocytes and plasm cells.

Some of the cells, especially the fast growing ones, showed various degenerative changes, like vacuolation of cytoplasm and karyorrhexis.

A variation in the appearance of this tumor was the one found on the skin of the animals and was of the papillary carcinomatous variety, which was a cauliflower type of growth consisting of folds of tissue with deep clefts between them. Microscopically this resembled papilloma but with malignant tendencies.

Comment. It would appear from a perusal of Table 1, that the eye is the seat of predilection for cancerous growth in bovines and equines. Why this should be has not been satisfactorily explained. Different workers have advanced different theories but none of them have been found to be satisfactory or convincing.

The role of actinic rays of the sun, photosensitisation and friction by yokes have been cited as possible causes (32). That a virus may probably incite the proliferation of the cells of the eye has also been put forward (201). The relation of vitamin A deficiency as a cause has been studied and it was

found that the eye cancer was rare in alphalpha fed animals and the warts on the head, neck and breast of young cattle disappeared after a run of 60 days on young succulent grass (10). Hereditary predisposition activated by sun burning was one of the causes cited (84).

The susceptibility of Hereford breed for this tumor in the eye is well known but so far the reason for the same is not known. Probably a sublethal factor may be responsible.

In India it was found that the horn was the most affected next to the eye (32). The pathogenesis of occular carcinomata in bovines has been studied in detail by Wyne and Russel (239).

It is reported that among dogs of England, the tonsils are the most affected tissues (40, 121) but it was found in these studies here that one animal alone had shown this tumor in the tonsillar tissue.

Epithelial tumors of pigs and sheep are rare. Is it because these animals are slaughtered early that few carcinomata are observed?

Carcinomata have been recorded by different authors among canines (40, 41, 88, 103, 166, 182, 211, 213, 234, 235, 236), bovines (6, 32, 69, 88, 99, 102, 103, 116, 125, 128, 158, 180, 181, 182, 235), equines (90, 178, 190, 199, 205, 235), felines (38, 119, 149, 159) and ovines (54, 103, 205, 209).

Tumors of the Non-Hemopoietic Mesenchymal Tissues.

Fibrobalstomata. Tumors of the fibrous tissue are very common in animals and are found in almost any place in the body where fibrous tissue is present. But the majority of the tumors are found to arise from the integuments, the favored sites being the skin of the head, neck, shoulder and leg.

A total of 98 neoplasms (i.e., 14.3% of all neoplasms and 49% of the non-hemopoietic mesenchymal tumors) of the fibrous tissues were received of which

27 were benign and 71 malignant.

The incidence of these tumors among different animals is shown in Table 2.

Table 2. Incidence of fibroblastomata among different animals.

Species	Fibromata		Fibrosarcomata	
	Number received	Number examined	Number received	Number examined
Canine	2	1	29	13
Bovine	8	3	7	2
Equine	17	1	35	3
Total	27	5	71	18

The sites of origin of these tumors among different animals are shown in Tables 3 and 4.

Table 3. Sites of origin of Fibromata among animals.

Species	Location	Number
Canine	Side of the head	1
	Mammary gland	1
Bovine	Vulva	2
	Vagina	2
	Penis	1
	Dehorned area	1
	Elbow	1
	Unknown	1
Equine	Cecum of a mule	1
	Eye	2
	Ear	1
	Fetlock	1
	Unknown	12

Table 4. Sites of origin of Fibrosarcomata among animals.

Species	Location	Number	
Canine	Limbs	10)	
	Ear	2)	
	Gums	1)	Among these, 7 were
	Soft palate	1)	metastastatic
	Spermatic cord	1)	
	Tail	1)	
Bovine	Penis	2	
	Nasal cavity	1	
	Vagina	1	
Equine	Cheek	1	
	Shoulder	2	
	Eye	8	
	Ear	1	
	Neck	1	
	Mouth	1	
	Sternal region	1	
	Prepuce	1	
	Inguinal region	1	

The case of a mule, in which a fibroma was found to involve the base of the cecum is described. The subject was a male mule, about 15 years old. It entered the hospital with an edematous swelling of the legs, jaws and between the fore legs. The animal was losing condition. The carcass was emaciated. Anemic infarction of the cortex of kidneys was noticed. A rounded tumor was situated in the mucosa of the base of the cecum. It was 4 × 5 × 6 inches in size. No apparent obstruction to colon was noticed. The tumor was fairly well capsulated. No metastases were seen.

Microscopically, the structure of a fibroma was very simple, consisting of fibroblasts and collagen fibers running in all directions. The tumor originated from the preexisting collagenous connective tissue. The fibroblasts were spindle shaped with an oval nucleus, which had a delicate chromatin and a single nucleolus. No mitotic figures were seen. The collagen

fibrils appeared in wavy bundles. Blood supply was fairly good.

The malignant variety, fibrosarcoma, usually arises from preexisting fibroma. Sometimes metastases are widespread in this tumor. One such case is described hereunder. The subject was an eight year old shepherd dog. It was reported to have been sick for only two weeks. It died while in the process of examination in the clinic. The peritoneal cavity was distended with bloody fluid and the pleural cavity likewise contained an increased amount. Much of the peritoneal surface had a mottled white appearance with some thickening. The neoplasm was apparent over the bladder, pelvic cavity, mesentery, omentum and diaphragm. The abdominal viscera, omentum, spleen and loops of intestines were knotted together with neoplastic tissue. There were numerous neoplastic nodules about 3/8 inches in diameter uniformly distributed through both the lungs. There was a firm white tumor mass on the right side on the peritoneal surface along the costal margin, about 5 × 3 × 2 inches in size. It was readily dissected away from the body wall. It was pale in color. The liver was largely neoplastic tissue. No gross metastasis in the brain could be observed. There were a number of pale areas up to 3/8 inches in diameter extending to the cortex of the kidney. There was an irregular shaped mass posterior to the stomach in the region of the pancreas, perhaps 6 × 4 × 2 inches in which the spleen, the root of the mesentery and the root of the pancreas were embedded. This mass was stripped away from the sublumbar muscles quite readily for there was no obvious infiltration.

Microscopically, fibrosarcoma consisted of fibroblasts which were in the embryonic stage of development. These were swollen, stubby cells with a large well stained nucleus, having a coarse granular evenly stippled chromatin and a single nucleolus. These fibroblasts had no orderly arrangement, being seen to run in all directions. Mitotic figures were many and bizarre. The tumor

had a very cellular appearance with scanty collagen formation. Sometimes the fibroblasts were arranged in whorls. Multinucleated tumor giant cells were present sometimes. The neoplastic cells were very invasive and infiltrated the adjacent tissues. Blood supply was plentiful, large numbers of thin walled blood vessels being present. Metastasis occurred by way of blood stream.

Comment. Clinically the fibromata can be removed surgically without recurring. They usually 'shell out'. On the other hand, fibrosarcomata are not so amenable to treatment, since recurrence is noticed and whenever metastases are present, they cannot be approached, being located deep in the internal organs.

Tumors of the fibrous tissue have been described in canines (2, 4, 40, 41, 88, 103, 166, 205, 218, 223, 234, 235), bovines (32, 75, 88, 103, 116, 181, 182), equines (103, 182, 198, 205, 225, 235), felines (88, 235) and ovines (103).

Sarcoid. One specimen was received from the sheath of a horse, in which, the histological structure closely resembled those described by Jackson (103) under "Equine Sarcoids". The characteristic clinical features of this tumor are: tendency to multiple occurrence, often rapid growth and the evidence that these tumors are transferred from one part of the body to another by contact. Their sites of predilection are the lower portions of the limbs, the eye lids, the lips, other parts of the skin of head and the sheath and penis. The gross appearance is that of a papilloma.

Microscopically, the tumor consisted of irregularly arranged bundles of fibroblasts. The amount of collagenous tissue present varied and sometimes could be confused with a fibroma. At other times, the tumor was so cellular as to merit the term 'sarcoma'. But the cells never showed anaplastic changes,

viz., gross irregularities of nuclear shape, hyperchromatosis and nuclear enlargement beyond the degree seen in non-neoplastic fibroblasts. Mitotic figures were observed. Numerous budding capillaries were also observed. These tumors had very little invasive propensities despite the fact that they were not encapsulated. Elongated rete pegs of the epidermis occurred.

Comment. These tumors have been designated by some workers as granulomas or sarcomas. Granuloma contains fluid or cellular exudate and may not recur after excision and therefore this tumor should not be classified as a granuloma. The term sarcoma cannot be tenable as the anaplastic changes noted in the sarcomata are not present in these tumors. Moreover, metastases which are a regular feature of the sarcomata are seldom found in these tumors.

There may be infiltration by lymphocytes and eosinophils but the latter is not to such a degree as to confuse one and mislead to a diagnosis of 'summer sores'.

These tumors cannot be classified as papillomata, since the latter are benign and have a distinct and different structure altogether.

So in an analogy with human neoplasms, this tumor is designated as a Sarcoid by Jackson (103), which is to mean a tumor of connective tissue with limited malignancy.

It may be observed that sarcoids have been described only in the equines. Apart from Jackson, Harmon (87) has described one sarcoid in a mule, Olson (177) in two horses and Sastry (205) in an ass.

Keloid. One case of a keloid from the leg of a horse was received. Strictly speaking this is not a true tumor but an over growth of a richly vascularised granulation tissue, usually due to infection of an injury. In the sections seen a dense collection of collagenous tissue with a few adult fibroblasts were observed. If infection was not present this could be

confused with a fibroma.

Nasal Polyps. Of the six equine polyps received, only three were examined. These are fibromata affecting the nasal passages and naso-pharynx, and arise from the submucous connective tissue, gradually pushing out into the lumen of the nasal passage. They were smooth, glistening and slimy to the touch. On section polyps were found to consist of fibrous tissue essentially, which was rather loose and oedematous. Infiltration by lymphocytes, monocytes and eosinophils was observed.

Comment. Because of the oedematous nature of the connective tissue, some of these tumors may be erroneously designated as myxo-fibromata. Actually no myxomatous tissue is present, and so should be called a fibroma. Chandrasekharan Nair and Sastry (32) have described 60 cases of nasal polyps in cattle and one in a water buffalo. Kenny (116) found two nasal polyps in bovines.

Neurofibromata. These arise from the lemocytes and fibroblasts of the collagenous tissue of the nerve trunks and so theoretically can occur on the course of any nerve. In the collection under review, one specimen was received from a horse.

Microscopically, the tumor consisted of long and spindle cells having oblong or oval fat nuclei, which had fine chromatin and single nucleoli. The cells were so arranged, side by side, that a pallisade arrangement of the nuclei was sometimes seen. But most commonly the cells had a whorled arrangement, which was very characteristic.

Comment. Cutaneous neurofibromatosis as seen in man, called Recklinghaussen's multiple neurofibromatosis, are not encountered among animals. Neurofibromata have been recorded in canines (166,205), bovines (32, 79, 92, 103, 182), equines (205, 235) and felines (235).

Myxoblastomata. Seven tumors were received affecting the mucin

producing connective tissue. Two of these affecting horses were malignant, while the rest were benign. The tumors were seen in the following animals: Two in canines, both from vagina, two in bovines, one of which was from the ear and one from an equine. The benign tumors were not available for study here. The malignant tumor studied was from a bay gelding 12 to 15 years of age, and was admitted to the hospital 12 days previously with pronounced difficulty in breathing. Respiration took place through the mouth. A bulging of the right side of the face was observed upon necropsy. When the tongue was removed a soft granuloma-like mass practically filled the posterior part of the right side of the nasal cavity. The septum was torn from its attachment by the operation and compressed by pressure of the tumor mass from below. There was also a round mass two cms. in diameter, laterally within about two inches of the nasal opening. The consistency of the tumor was somewhat mucoid.

Microscopically, the myxosarcoma consisted of spindle shaped or stellate cells in very scant basophilic mucinous matrix. The mucin when present appeared to be in the meshes of the processes of the stellate cells. No mitotic figures were seen and the tumor had no well defined capsule. This tumor showed invasive tendencies.

Comment. Tumors of the mucin producing tissue are rare and few authors have recorded them among domesticated animals. Jackson (103) has recorded this tumor in horses and sheep, Mulligan (166) among seven dogs and Kenny (116) and Plummer (182) among bovines.

Lipomata. Lipoma is a tumor arising from fat cells and their supporting elements. A total of 20 lipomata were received from animals as shown in Table 5.

Table 5. Incidence and sites of origin of lipomata among domesticated animals.

Species	Number received	Number examined	Location	Number
Canine	15	1	Lateral and dorsal to vagina	1
			Shoulder	1
			Anterior to mammary gland	1
			Head	1
			Chest	1
Bovine	4	1	Genital tract	1
			Side of face	1
			Abdomen	1
Equine	1	1	Abdomen	1

Microscopically, the tissue consisted of large polyhedral fat cells containing fat (which in the hemotoxylin and eosin sections appeared as vacuoles) with a shrunken nucleus thrust to a side. A well developed capsule was present and a generous blood supply was seen.

Comment. The lipomata are usually harmless unless they are situated in or near important organs, which is very rare. These may be surgically removed without any recurrence.

These tumors are fairly common and have been recorded among canines (40, 88, 103, 166, 235), bovines (32, 103, 116, 234), equines (103, 198), felines (38) and ovines (103).

Edgson (57) has described the condition known as lipomatosis in which a great increase in fat tissue is noticed, especially around the abdominal viscera. He thinks the condition has some genetical connection.

Chondroblastomata. Chondroblastomata consist principally of cartilage, the cells of which are derived from undifferentiated mesenchymal cells. Four benign and two malignant tumors of the cartilage were received. Two of the benign tumors were found in dogs and the others in sheep. One of the ovine

tumors was not examined. Of the canine tumors, one was found involving the vertebrae and the other was found in the frontal sinus. The former case is described. The subject was a German shepherd female dog 10 years of age. The animal had shown a posterior weakness with a rounded swelling on the back for three years. It had been growing rapidly for the past three months. The dog was destroyed for necropsy. The tumor had developed over the third lumbar vertebra. The neoplastic process had apparently extended into the spinal canal. No metastasis was noticed.

Microscopically, typical cartilage cells were found in groups of two and more in a basophilic matrix which was homogeneous. The tumor was divided into lobule-like areas by strands of connective tissue. In the undifferentiated portions, especially at the periphery, the cells appeared spindle-shaped.

One of the two chondrosarcomata was found in a steer and the other in a horse. The steer was a two year old and had a history of an injury about the head. A tumor mass was found filling the temporal fossa. It did not seem to involve the bone nor could any pressure on the brain be determined. There were many palpable tumor masses in the lungs. Many of them had a diameter of 1/2 inch.

The equine tumor was not examined.

Microscopically, the tumor consisted of islands of hyaline cartilage in a dense fibrous tissue. The cells stained a deeply bluish color and showed signs of anaplasia. They were huge round cells with a vacuolated round nucleus, and numerous mitoses. The fibrous connective tissue was very cellular and mitotic figures could also be seen in these cells. In some areas fully differentiated adult cartilage was observed and in other parts spicules of bone were seen. Numerous thin walled blood vessels were seen. Small groups of neoplastic cells were seen to invade the adjacent tissue. This same

picture was observed in the metastastatic nodules in the lung where-in the 'nodules' were encapsulated.

Comment. Cartilage may arise from the periosteal fibrous tissue by gradual transformation. But in some situations, it may arise from ordinary fibrous tissue,also by metaplasia as is found in the canine mammary tumors. Usually tumors of the cartilage are found in places where normally cartilage is found.

Chondroblastomata are considered to be rare. They have been reported among canines (85, 86, 166, 235), bovines (32, 103), equines (103), felines (235) and ovines (205, 235).

Osteoblastomata. Normally bone arises by the activity of osteoblasts which are modified fibroblasts. Hence, bone also can arise from fibrous tissue. But more commonly, these tumors arise from the already existing bony tissue.

Five osteomata of horses were received, only one of which was examined. This arose from the interdental space and measured 8 × 9 × 6 cms.

Microscopically, the osteoma resembled bone, but the resemblance was never complete. In the decalcified specimen, the section appeared as a homogeneous mass of acidophilic material with osteoblasts strewn in. The concentric lamellae could be seen but the finer details like canaliculi and haversian canals could not be identified.

Of the 13 osteosarcomata received, eight were found in canines, one in a bovine and four in equines. One canine tumor and all the equine tumors were not examined. The sites of origin of these tumors are shown in Table 6.

Osteosarcomata are highly malignant, widespread metastases taking place. A bovine and a canine case are described as examples.

(i) A seven year old Hereford cow was presented to the clinic for

Table 6. Sites of origin of the osteosarcomata among different animals.

Species	Location	Number	Remarks
Canine	Ulna and radius	1	
	Stifle	1	Metastases into lungs
Bovine	Scapular region	1	Metastases into lungs
Equine	Sinus	1	
	Mouth	1	

lameness that had persisted for a year. An enlargement of the right scapular region was noticed with a growth that weighed 32.24 lbs. Temperature and pulse were normal. Necropsy examination revealed considerable edema medial to the scapula in the right thoracic wall. Thirty nodules with commencing calcification were found in the lungs, the largest being one inch in diameter.

(ii) The subject was a three year old black Labrador retriever. The dog was lame when brought to the clinic. A diagnosis of prostatitis with accompanying arthritis of the right coxofemoral articulation was made. Two months later, a swelling of the right stifle joint was seen. Fluoroscopic examination revealed a hematoma. Within another month, the tumor was growing rapidly. X-ray revealed an osteogenic sarcoma. The leg was amputated at the middle of the femur. Material from this tissue revealed an osteogenic sarcoma.

Following amputation, the dog recovered and appeared in excellent health. Exactly three months after amputation, difficulty in breathing was noticed. A diagnosis of bronchitis and broncho-pneumonia was made. Three weeks later, the dog returned in very poor health with tachycardia and pyrexia, marked emaciation, edema of extremities and dyspnea. The animal was destroyed. On necropsy, 24 cutaneous tumors varying in size from one fourth to one inch in diameter were found distributed all over the body. Several of the larger

ones were located along the thoracic vertebrae. The lungs were literally riddled with nodules and masses of neoplastic tissue. There were no visible tumors in the liver. The kidneys had a few nodules. The amputation stump showed no neoplastic growth and had healed normally.

Microscopically, the sections of osteogenic sarcoma were very cellular with numerous osteoblasts which were spindle or ovoid or polyhedral with hyperchromatic nuclei and single nucleoli. Numerous mitotic figures were seen. Spicules of bone were observed here and there. The osteoblasts were arranged in wavy bundles. Numerous thin walled blood vessels were observed. The tumor cells were highly invasive and actual invasion of the adjacent tissue was noticed.

In the metastases, the tumors were capsulated, which had the same histology described above.

Comment. It is not difficult to diagnose the tumors of the bone, especially by the aid of x-rays. One should, however, be careful to distinguish between exostoses and true tumors, the former occurring usually as a result of inflammation. Osteogenic sarcomata are very painful and hence the lameness.

Osteoblastomata have been reported in canines (39, 40, 41, 166, 175, 215, 219, 234, 235), bovines (83, 103), equines (70, 78, 198) and ovines (103).

Osteoclastomata. These tumors are sometimes described as giant-cell tumors, and are considered to arise from the osteoclasts of the bones.

One osteoclastoma from the lower jaw of an eleven year old dog was received.

Microscopically, this tumor consisted of numerous osteoclasts in a fibrous tissue-like-stroma. The osteoclasts resembled the foreign body giant cells in structure. Mitotic figures were not seen among the osteoclasts but

were found in the surrounding osteoblasts. The fibrous tissue in many parts showed hyaline changes. The osteoclasts were of different sizes and shapes.

Comment. Some authors doubt if this is a true tumor or only an inflammatory reaction. The absence of foreign material distinguishes the tumor from the latter condition.

Nielson (172) has described an extraskeletal giant cell tumor in a cat.

Leiomyoblastomata. These are tumors arising from the smooth muscle fibers. Ten tumors of the smooth muscle tissue were received, six being benign and the rest malignant. The incidence and sites of origin of these tumors are shown in Table 7.

Table 7. Incidence and sites of origin of leiomyoblastomata among animals.

Species	Location	Number	Remarks
Canine	Abdominal cavity	1	Benign
	Head	1	Malignant
	Rectum	1	Malignant - not examined
Bovine	Sphincter ani	1	Benign
	Vagina	1	Benign (8 1/2 lbs.) - not examined
	Heart	1	Malignant
Equine	Esophagus	1	Benign
	Uterus	1	Benign
Porcine	Rectum	1	Benign - not examined
Ovine	Rumen	1	Malignant - metastases into liver

Microscopically, the benign leiomyoma consisted of bundles of muscle fibers separated by strands of fibrous connective tissue in which plentiful blood supply was found. The neoplastic cells were usually elongated, spindle shaped but plump and short cells were also observed. The cytoplasm was acidophilic and plump ovoid nuclei with rounded ends having a filamentous homogeneous chromatin and small round or rod shaped basophilic nucleoli.

Among these cells a few fibroblasts could also be seen. At the periphery of the tumor the neoplastic muscle cells merged imperceptably with the normal tissue.

In the malignant forms, the cells were anaplastic and were more numerous, plumper, shorter with larger and thicker nuclei. Numerous mitotic figures were seen. The cytoplasm was basophilic. These cells were very highly invasive, and tumor giant cells were frequently seen. Thin walled blood vessels were present.

Comment. Usually these tumors are situated in the interior of the body and so surgical intervention is not very successful. The malignant forms give rise to metastases with fatal results. Leiomyoblastomata are not rare, these having been recorded among canines (41, 103, 166, 223, 235), bovines (32, 33) and ovines (103).

Rhabdomyoblastomata. Rhabdomyoblastoma is a tumor arising from the striated muscle fibers. Only one benign tumor of the striated muscle was received. This was from the tongue of a horse. The subject was a six year old mare. The neoplasm was removed surgically.

Microscopically, the tumor consisted of bundles of striated muscle cells, disposed of in different directions. No mitotic figures were seen. Fibrous tissue stroma was limited to the septa dividing the bundles.

Comment. Rhabdomyomata are one of the rarer tumors. Worley and Gorham (237) have described a rhabdomyosarcoma on the left stifle joint of an eight year old male English setter.

Mixed Tumors. Tumors consisting of two types of mesenchymal tissues are frequently encountered. When the potentialities of the fibroblasts for proliferation and metaplastic changes are taken into account, it is not difficult to understand the reason for the occurrence of tumors like fibro-

chondroma, fibromyxoma, etc.

The following mixed tumors were received in this laboratory:

Table 8. Types of mixed tumors received with hosts and locations.

Type of tumor	Number*	Host	Location
Fibrochondroma	2	Canine	
Fibrolipoma	1	Canine	
	1	Porcine	
Osteofibroma	1	Bovine	Anterior portion of mandible
	1	Equine	

* Of these only the bovine tumor was examined.

The bovine tumor was obtained from the mandible of an emaciated, long horned Texas steer of uncertain age. It measured 8 1/2 × 6 × 5 inches and weighed 3850 gms. The tumor was removed surgically but the animal died.

Microscopically, these mixed tumors had simple structure having both the fibrous connective tissue as well as a second tissue, viz., cartilage, fat, or bone. The relative amounts of the two tissues varied from specimen to specimen.

Usually these tumors are single and do not recur after removal.

Angiomata. Angiomata may be hemangiomata, when they are formed of the blood vascular endothelium or lymphangiomata when they consist of tumors formed of lymph vascular endothelium.

Six hemangiomata and one lymphangioma were received. The incidence and location of the former are shown in Table 9.

The porcine tumor measured about four inches in diameter, dark in color and rather soft in consistency when removed from the uterus of a three year old sow. The attachment had completely obliterated the ovary. During the

last four months of its life an ascites had developed which amounted to 15 gallons of fluid.

Table 9. Incidence and location of hemangiomata among animals.

Species	Location	Number	Remarks
Canine	Subcutaneous tissue	1	Benign - cavernous
	Subcutaneous tissue	1	Benign - not examined
	Hind limb	1	Benign - not examined
Bovine	Liver	1	Benign - not examined
Equine	Thoracic cavity	1	Malignant
Porcine	Uterus	1	Benign - cavernous

Microscopically, the cavernous hemangioma consisted of cavities, lined by endothelium, mostly containing red blood cells. The endothelial cells sometimes proliferated as to completely fill the cavity. The cells were oval or polyhedral. Sometimes they were flattened or spindle shaped. The cytoplasm was clear or slightly basophilic. Nuclei were large and oval and contained fine chromatin. Mitotic figures were numerous.

The malignant hemangioendothelioma, also called angiosarcoma, occurring in the horse, completely filled the thoracic inlet and extended into the mediastinum. It surrounded the trachea, the bifurcation of the aorta and musculature of the heart. Granular tumor masses were developing over the pericardium, apparently spreading through the lymphatics.

Microscopically, the tumor consisted of small nodules scattered in the lung, without a definite capsule. The cells were in solid masses and very anaplastic, polyhedral with large vesicular rounded nuclei. The cytoplasm was acidophilic and in some places also basophilic. Two nucleoli were observed. Numerous mitotic figures were seen. Many thin walled blood

capillaries were found throughout the tumor and in some places the tumor cells themselves appeared to line blood vessels.

Comment. The bovine liver is considered to be prone to the formation of telangectasis or angiomatosis or cavernous angioma. This condition sometimes ends fatally due to rupture of the liver and consequent internal haemorrhage.

If superficial, the benign variety can be removed. But haemorrhages may be excessive and sometimes difficult to control. The angiosarcoma is highly malignant, metastases occurring due to the great intimacy of the tumor cells and the blood vascular system.

Tumors of blood vascular spaces have been reported among canines (40, 60, 88, 103, 136, 151, 166, 182, 183, 188, 235), bovines (24, 32, 103), equines (103, 203), porcines (103), felines (88, 182) and ovines (50, 103).

The lymphangioma was obtained from the uterus of a mare and consisted of lymph spaces or cavities lined by endothelium. These spaces contained lymph. These tumors are extremely rare in animals and very few references are found. Among canines (88, 166) and a porcine (182) this tumor was recorded.

Mesotheliomata. Mesothelioblastoma is composed of cells of varied potentialities, the precursors of which are derived from the mesodermal elements lining the primitive coelomic cavity. These cells cover the surfaces of all serous membranes (66). Of the three tumors received from equines, one, found in the thoracic cavity, was examined.

Microscopically, the tumor consisted of cells, resembling epithelial cells, which were arranged in alveolar or gland like formation. These alveoli had no basement membrane but the cells of the two adjacent alveoli appeared to touch each other. The cells had acidophilic granular cytoplasm and a big vesicular nucleus with fine chromatin. Mitotic figures were seen

in small numbers. Numerous blood capillaries traversed within the tumor mass. The cells were invasive. Fibrous tissue stroma was scanty. Large numbers of eosinophils were present. In some areas large sheets of cells were seen, resembling a carcinomatous arrangement.

Infection in some parts was evident with necrosis and leucocytic infiltration.

Comment. Mesothelial cells derived from the mesoderm are multipotent and can be converted into fibroblasts. So in some tumors a great increase in this type of tissue occurs and may so predominate as to be called a sarcoma. In some other cases because of the epithelial nature of the cells lining the serous cavities a carcinomatous appearance is obtained.

Mesothelioblastomata have been recorded in canines (192), bovines (103, 113, 181) and equines (103). Jackson (103) has given an excellent description of peritoneal, pericardial and pleural mesotheliomata.

Hemangiopericytomata. These are tumors originating from the pericytes of Zimmerman, which are the adventitial cells of the blood vessels.

Formerly these tumors were diagnosed as neurofibroma, neurofibrosarcoma, neurilemmoma, fibroma, fibrosarcoma, hemangioendothelioma, leiomyoma or leiomyosarcoma.

Four tumors coming under this category were received, all from dogs. One case was in the tibial region and another on the right commissure of the mouth.

Microscopically, the cells comprising the tumor were characteristically arranged around the lumina of small blood vessels. These were either small arterioles or even closed capillaries. In most cases, the cells were concentrically laminated around vascular spaces lined by endothelium and had a characteristic 'finger print' appearance.

The type cell was spindle shaped, but with an ovoid nucleus having heavy coarsely granular nuclear membrane and a finely-meshed loose chromatin. Mitotic figures varied in different tumors, numerous in one and not so frequent in another.

Another significant feature about the neoplasm was the intimate association between the cells and the vascular spaces - in fact the relationship was so intimate as though one could not exist without the other.

In some parts of the tumor, the lumina of the vessels were obliterated due to sclerosis. Such areas were prone to calcium deposition. Silver impregnation method of Foot (72) had clearly demarcated the reticular fibers around the vessels against the tumor cells.

Comment. This neoplasm is identified by two cardinal features:

(i) The 'finger print' arrangement and (ii) the intimate relationship between the cells and blood vessels. Such a relationship is not seen in other tumors resembling pericytoma. In this tumor the cells proliferate around a blood vessel while in an endothelioma the cells proliferate inside the blood vessel.

Pericytomata are situated mostly subcutaneously and are not very malignant. Recurrence is noticed in a small percentage of cases. Metastases do not occur.

Pericytomata have been described only in dogs (169, 240).

Mastocytomata. Tumors composed of mast cells are found mostly in dogs. Fifteen tumors were received from dogs. All the tumors had subcutaneous location and the sites of some of them were: thigh, cheek, mammary region, gluteal region and vulva.

Microscopically, the size and shape of the cells varied according to their stage of development. In more mature forms, the cells were rounded,

with faint granular acidophilic cytoplasm and a relatively small rounded nucleus. A distinct perinuclear membrane was observed. In immature or anaplastic forms, these cells were polyhedral, or even angular with a faintly basophilic cytoplasm and a relatively large nucleus which appeared to be vesicular. In the mature cells large basophilic granules were seen while these were usually absent in the anaplastic type of cells. Mitotic figures were not seen in the tumors under study. Rarely binucleate giant cell-like cells were encountered.

The neoplastic cells were clustered together and were seen to invade the adjacent tissue. Eosinophils and lymphocytes were observed in large numbers. Hyaline changes around the blood vessels were noticed occasionally. The fibrous tissue stroma was plentiful and in some tumors so great that one was tempted to call it a fibroma.

The granules were well delineated by staining with Giemsa's stain or, Toludine blue. The granules in one gave a positive periodic-acid-Schiff reaction.

Comment. Mast cells are found normally in the connective tissue and are particularly numerous around small blood vessels of the liver. Though mitotic figures may not be present, these tumors are considered to be "always cancerous" (166). There may be multiple tumors and rarely metastases, one such case being described here. The subject was a small female dog having a tumor about 1 1/4 inch in diameter on the inner gluteal region. There were quite a number of small (2 to 4 mm.) red, raised nodules on the surface of the spleen, several pale areas on the pancreas and one reddish pale area on the borders of the lung. These tumors had the same structure as the mastocytoma.

Mast cell tumors are almost always subcutaneous in location and are

white in color and fairly hard in consistency. Mastocytomata are sometimes confused with veneral sarcomata. In the former the cells are less uniform in size and shape while the nuclei are more deeply staining in the cells of the latter. Mastocytoma may also be mistaken for malignant lymphoma. But the nuclei of the cells of the latter are more loose and stain less densely than those of the former. The presence of the basophilic granules in the cytoplasm brought out by special stains,of course,helps in the correct diagnosis.

These tumors have been found to secrete heparin (30) and it is also suggested that the heparin secreted into the tissues becomes hyaluronic acid (191).

Cortisone injection caused a rapid regression of multiple mast cell tumors (17) but the tumors recurred after the cortisone was discontinued (28).

Mast cell tumors have been reported in canines (12, 30, 40, 41, 88, 163, 166, 173, 235), bovines (88) and felines (168).

Tumors of Haemopoietic Tissues

Lymphocytomata. Next to the squammous-cell carcinoma, tumors of the lymphoid elements are the most frequently occurring neoplasms in the domesticated animals. Lymphoblastomata have been described under diverse names by different authors, viz., lymphadenoma, pseudoleukemia, lymphoma, leukemia, lymphocytoma, alveolar sarcoma, lymphosarcomatosis, round-cell sarcoma, lymphatic leukemia, lymphosarcoma, Hodgkin's disease and malignant lymphoma. But essentially the disease process is the same in all these conditions, viz., a malignant neoplastic proliferation of the lymphoid tissue. As such, nothing is gained by calling the same tumor by different names simply because the

stage of anaplasia or differentiation varies in different tumors. So Feldman (66) calls these tumors lymphocytomata, supported by Thompson and Roderick (231), who observe that 'lymphocytoma seems to be the most appropriate designation'. But Willis (235) calls these tumors lymphosarcoma, which is also supported by Mulligan (166). In these studies, the name lymphocytoma is adopted.

Lymphocytoma is one of the most malignant neoplasms. No tissue is immune against this tumor and metastasis is usually widespread. Sometimes the whole body is riddled with these tumors as exemplified by a case described below. These tumors appear to have a multicentric origin in different leukopoietic organs. Hence the condition seen in lymph nodes and spleen does not denote metastases but a simultaneous independent neoplastic change of the tissue elements of these organs.

Tumors consisting of the neoplastic cells are seen in different organs as white soft nodules.

Blood picture may or may not be abnormal depending upon whether the condition is leukemic or aleukemic. In the former the total white cell count is abnormally high, of which 90 to 95 per cent are cells of the lymphocytic series. Bone marrow shows infiltration with these cells with myelophthisic anemia supervening.

One hundred forty nine lymphocytomata (i.e., 21.3% of all tumors) were received in this laboratory and the details are shown in Table 10.

The following case illustrates the extent of metastasis that one could find in this condition. The subject was a 12 year old Shorthorn milking cow. On admission to the clinic, a marked swelling of the ventral side of the body wall was observed extending from the udder to and including the brisket. The supramammary lymphnode was enlarged about six to eight times and a

Table 10. Incidence of lymphocytoma among different animals, together with location of some of them.

Species	Number received	Number examined	Location	Number
Canine	44	33	Mouth	1
			Foot	2
			Ear	1
			Skin	1
			Liver, spleen, lungs, lymph glands	10
Bovine	70	24	Skin	2
			Brain	1
			Abdomen	1
			Rectum	1
			Lymphnode	1
			Uterus, cervix, vagina	1
			Mesentary	1
			Extensive involvement of body	1
Equine	6	2	Liver	1
			Canthus of eye	1
Porcine	22	11	Liver and viscera	9
			Cranial cavity	1
			Kidney and bladder	1
Feline	4	1	Liver	1
			Kidney	1
			Spleen (ruptured)	1
Ovine	3	1	Lymphnode	1
Total	149			

necrotic portion of it had broken through on the posterior aspect of the udder. The prefemoral lymph nodes were enlarged four to six times. The animal was normally alert and had a good appetite. She showed some difficulty in walking apparently because of the swelling.

The owner stated that although the cow had always had a large udder and had been an exceptionally good milker, the udder had appeared to be getting larger during the previous six weeks. The other swellings had appeared

during the previous two weeks.

The following blood picture was noticed on admission:

Erythrocytes	4,750,000 per cmm.
Leucocytes	73,500 per cmm.
Haemoglobin	7.5 per cent
Lymphocytes	90 per cent
Stabs	4 per cent
Segmenters	6 per cent

Based on the symptoms and blood picture a diagnosis of lymphocytoma was made.

Urine had a low sp. gr. - 1013 -, a positive test for albumin and pus cells.

At necropsy the carcass was in a fairly well nourished state. The swelling on the ventral body-wall was fibrino-edematous mass and there appeared to be some cellular infiltration. The udder tissue appeared to be normal but the supramammary lymph node was greatly enlarged, congested and half of it was necrotic.

The left external pudic artery and several of its satellite veins were enclosed in a mass of infiltrated tissue which was about 2 × 1 inch in cross section and six to eight inches long. The veins were completely occluded by thrombi.

Scattered over the wall of the rumen and in the wall of the intestine, throughout its length, were small disc-like patches of infiltrated tissue. On the greater curvature of the omasum there was a long mass of infiltrated tissue about 1 × 3 inches in cross section and about 12 to 14 inches in length. The right kidney appeared normal but in the left the cortex of many lobules appeared to be infiltrated. The external ileac lymphnodes were greatly enlarged. The abdominal muscles near their origin were grayish-white in color suggesting cellular infiltration.

The heart showed a few nodules of cellular infiltration and a consider-

able amount of diffuse pinkish grey infiltration throughout the myocardium. There was also a limited patchy diffuse infiltration on the costal pleura and a slight yellowish discoloration of the sheathing of the brachial nerves.

Microscopically, the type cell may vary depending on its differentiation. In the highly differentiated tumors, the cell was irregularly spherical, with a narrow zone of non-granular cytoplasm, which was basophilic with a slightly eccentrically situated nucleus. The nucleus formed the bulk of the cell and was intensely basophilic, dark staining and had coarse chromatin. Nucleoli were not easily seen. Numerous mitotic figures in different phases were present.

In the more rapidly growing tumors with greater anaplasia, cells were large, polyhedral with a large nucleus, which showed a vesicular type of loose chromatin. The cytoplasm was intensely blue. The nucleus was rounded or ovoid.

Stroma was scanty and blood vessels few. The blood appeared to lie in direct contact with the cells.

In the lymph nodes, the lyphatic tissue was replaced by the neoplastic cells and the reticulum cells, to some extent, showed proliferation. In the liver, infiltration was nodular or it was a microscopically generalised condition. The infiltration was first noticed around the portal triads. The parenchyma was slowly replaced and the remaining hepatic cells showed fatty degeneration and even necrosis.

In the spleen, the splenic tissue was replaced by the neoplastic cells. The Malphighian corpuscles disappeared or appeared enlarged. In the kidney, the infiltration was interstitial in the early stages. The tubules were crowded and showed varying stages of degeneration and atrophy. In some places, frank nodules were seen. In the musculature and the heart, the cells

infiltrated between the muscle fibers, which became atrophied, fragmented and destroyed. In the stomach and intestines, the infiltration was at first submucous, slowly infiltrating the muscular coat below and the mucosa above. In the nerves, the cells accumulated between the neurofibrils, separating them widely. In the brain, focal nodular accumulations was observed with destruction of the neurons.

The blood in the leukemic condition showed leucocytosis with lymphocytosis and secondary anemia. Depending upon the maturity of the cell, the lyphocytes may be either of the small lyphocyte variety or may be large lymphoblastic. These had, a large cellular body, with an intensely bluish staining non-granular cytoplasm and a large bluish slightly vesicular (loose) nucleus, which was round and eccentrically placed.

Reticulum-cell Sarcoma. In some instances, the cells may be very undifferentiated and designated as reticulum-cell 'sarcoma'. These were large, ovoid cells with delicate vesicular nuclei and pale cytoplasm. These resembled epithelium and sometimes mistaken for metastatic carcinoma. One of the canine lymphocytomata was of this type.

Comment. The figures quoted above support the statement of Feldman (66) "without question this disease is most common in the bovine species, the horse is rarely affected." That a genetical factor is probably involved was suggested (224). The tumors are not infectious or contagious (122, 224). Treatment with synthetic estrogens had given some encouraging results in dogs (50).

Some oncologists doubt the neoplastic nature of lymphocytoma. They contend that it is merely a hyperplastic condition of the lymphoid tissue. But the high degree of anaplasia, numerous mitoses and the widespread metastases and the extreme degree of infiltration and destruction wrought by the

cells in these tumors suggest that the process is neoplastic and not a mere hyperplasia.

Englebreth-Holm (59) has given an excellent review of the leukemias - natural and experimental - in animals.

As the condition is very common, it has been recorded by many workers among canines (3, 19, 26, 35, 41, 103, 118, 138, 166, 234), bovines (25, 32, 65, 80, 88, 103, 108, 181, 182), equines (48, 88, 189, 200), porcines (11, 23, 91, 117, 182), felines (38, 88, 94, 168, 174) and ovines (88, 103, 235).

Reticulum-cell sarcoma has been reported among canines (110, 181, 182, 234), bovines (9, 179), porcines (182) and felines (93).

Myeloid Leukemia. Neoplastic growth of the myeloid tissue is sometimes met with, but many cases remain unnoticed while alive. Most of the cases are diagnosed at necropsy. The neoplastic cells that arise from the precursors of the granulocytes infiltrate into various organs and those mostly affected are the liver, spleen and kidney. Leukemic and aleukemic forms may also occur. In the former, the blood is loaded with the immature neoplastic cells. Sometimes, tumorous masses of the neoplastic cells may be present as nodules in different parts of the body when they are called myelomata. The spleen and liver are usually very much enlarged, friable and somewhat paler than normal. Greyish spots or streaks may be seen on the surface of the liver. In the leukemic forms the white cell counts are abnormally high, with myelocytes predominating. Affected tissues are sometimes green in color, and the tumors are usually white and soft in consistency.

Fourteen cases of myelocytoma were received of which four were from dogs (one of which was not examined), nine from cattle (two not examined) and one from a pig. The tissues involved are detailed in Table 11.

Microscopically, the picture varied in different tumors depending on the

stage of development. All grades of development, from the primitive myeloblast to the well differentiated myelocytes were seen.

Table 11. Details regarding myelocytomata among animals.

Species	Age	Tissue involved	WBC count	Predominant cell type
Canine	12 years	Spleen - a mass of tumor 5 in. in diameter, bone marrow hyperplastic.	40,600	Neutrophil Myelocyte
	9 years	All lymph glands and liver enlarged. Spleen weighed 21 lb. and was 14 × 7 1/2 × 1 1/2 in.	44,400	Eosinophil Mylelocyte
	8 years	Spleen	350,000	Neutrophil
Bovine	- -	Muscle	---	Eosinophil
	2 years	Pharyngeal region thickened. Tumors in soft-palate, liver and spleen.	13,000	Eosinophil
	- -	Spleen and lymph gland	---	Neutrophil
	14 months	Muscle was green	---	Eosinophil
	- -	Liver	---	Eosinophil
Porcine	9 months	Spleen enlarged, bone marrow hyperplastic, lymph glands swollen.	---	Neutrophil

Five of the tumors had a predominantly eosinophilic myelocyte. Here the tissues were mostly infiltrated with eosinophil myelocytes. A few basophil and neutrophil myelocytes were also seen. The other four had the neutrophil myelocyte type of cells. These cells were rather larger, polyhedral or rounded with prominant rounded or oval eccentrically situated vesicular nuclei. The nuclei were sometimes indented. Nuclear chromatin was rather coarse.

The cytoplasm was faintly acidophilic or in many places neutrophilic. Megakaryocytes were seen in two specimens. A few lymphocytes were also noticed.

In the liver, the neoplastic cells virtually replaced the parenchyma, which showed fibrosis, and some hepatic cells underwent fatty degeneration. In the spleen, the pulp was replaced by the tumor cells and in some places the splenic tissue showed hyaline changes. In the muscle the neoplastic cells invaded, separating the muscle fibers. In the kidney these cells infiltrated between the tubules and had a focal distribution.

Blood smears from two cases - one eosinophilic and the other neutrophilic - were examined. In the former, the predominant cell was the eosinophil myelocyte, which made up to 50 per cent of the total number of leucocytes. The rest of the cells were composed of myeloblasts, neutrophil meylocytes and basophil myelocytes. In the second smear, the predominant cells were the neutrophil myelocytes. In these cells, the cytoplasm contained the characteristic granules and the nuclei were rounded and somewhat vesicular.

Comment. Though the eosinophil myelocytoma is easy to diagnose, the tumors in which the neutrophil myelocytes predominate may be confused for lymphocytoma. In the latter, the cells are more uniform and smaller in size with a denser and condensed nucleus. Giant cells are not seen in lymphocytomata.

The type cell may also be a plasma cell myelocytoma when the condition is called plasma-cell myeloma. In man this tumor is called multiple myeloma and affects many long bones.

Innes, et al. (101) and McClelland (140) have described myelocytomata in dogs. Plasma cell mylocytomata have been described in dogs by Bloom (15), Cordy (37) and Jennings (109).

Lillie (135) has described a mast-cell myelocytic leukemia in a cat.

Hodgkin's Disease. This is primarily a hyperplastic disease of the lymphoid tissue, involving other organs in later stages. The changes may be found simultaneously in all the lymph nodes or only in some or the disease process may be found to originate in the spleen.

It is said that the condition as found in the human subject is not met with in lower animals. It has not been reproduced in laboratory animals.

One instance of Hodgkin's disease-like condition was met with in a hog. The spleen and liver were available for study. The spleen was soft and enlarged while the liver was cirrhotic.

Microscopically, the lyphoid tissue of the spleen was replaced by acidophilic granulocytes. In some places, the reticulo-endothelial cells had proliferated enormously and showed polyhedral cells with a large vesicular nucleus. Numerous Stenberg-Reed giant cells were present. These were large, basophilic cells with a bilobed nucleus. In some places there were also multinucleated giant cells. The process was a granulomatous one, slowly developing, which would ultimately result in a great fibrosis of the spleen. But in this specimen, fibrosis in large scale had not yet occurred.

In the liver, the picture was quite different. Perilobular and periportal connective tissue was much increased and the parenchymatous cells showed varying degrees of degeneration. Nodular accumulation of neoplastic elements were present, viz., small round cells, eosiniphils and giant cells. These nodules appeared to enlarge by expansion.

Comment. Is Hodgkin's disease an inflammatory process? Foot (72) decides that it is a tumor since "it appears to comport itself more like the latter."

Inflammatory elements (viz., eosiniphils, plasma cells), the giant cells

and fibrosis make up the complete 'Hodgkin's triology'. Based on this conception, is the tumor described above Hodgkin's disease? In the spleen fibrosis is not very evident. But on that score it should not be decided that it is not Hodgkin's disease. For fibrosis "may begin early in the disease or appear later on after it is well established" (Foot, 72). In the liver, the triology are seen and the fibrosis is well developed. So this condition has been designated as Hodgkin's disease or a condition very similar to it.

Hodgkin's disease may be confused for tuberculosis or lymphosarcoma. In the former caseous necrosis and definite tendency for the nodules to break down and fuse with one another is observed, while in the latter one does not find the granulomatous appearance but a much more cellular neoplastic microscopic picture. Condition simulating Hodgkin's disease has been reported in dogs (7, 16, 147, 161) and pigs (74, 206).

Tumors of the Neural Tissues

Schwannomata. This is otherwise known as neurilemmoma and arises from the cells of the sheath of Schwann or 'lemocytes'. These tumors are usually small in size, a few centimeters in diameter, and are situated on the course of nerve fibers. Schwannomata are almost always seen in internal organs or deeper somatic structures.

One schwannoma from a cow was received. This was found in the spinal canal, on a nerve root. Muscular incoordination was observed.

Microscopically, the type cell was an elongated and spindle shaped one with oval or cylindrical nuclei. Distinct pallisading of the nuclei was observed which was very characteristic. Equally characteristic was the alignment of the cells in interlacing facsiculi which were arranged with

alternating bundles of connective tissue resembling the 'Antony type A' tissue of the human pathologists. Whorling of the bundles into Verocay bodies was also seen.

In this tumor the 'Antony type B' arrangement was not noticed. No demonstrable capsule around the nodules could be seen.

Comment. Schwannomas are considered to be benign. These may be confused for a fibroma but in the latter the whorled appearance is not met with. The type cell of the schwannoma is more delicate and smaller than a fibroblast. Schwannoma may also be confused for a myxoma but in the former the stellate cells are not met with nor can Verocay bodies be found in the latter.

Multiple schwannomas were described in cattle by Monlux and Davis (157).

Medulloblastomata. This is one of the rare tumors of the brain tissue and is supposed to arise from the embryonal glial tissue. This neoplasm is malignant and is found to affect the younger people in human pathology.

One specimen was received from a four year old German shepherd female dog. Five weeks prior to admission into the clinic a small depression was noticed under the right eye. Three weeks later, the dog was found to show greater depression on the eye, difficult locomotion, staggering towards the right side and facial paralysis. Twelve days after this, the dog had become blind and deaf and could not eat anything. It was in a moribund condition and was destroyed.

At necropsy, the dog was observed to have abundant fat in the body. The scutularis muscle of the right side of the head was markedly atrophied. The abdominal and thoracic viscera were essentially normal.

Attached to the lateral surface of the cerebellum and the medulla was a soft rounded mass of pale pink color and approximately one inch in diameter. It had apparently arisen from the cerebellum for it was more loosely attached

to the medulla which was considerably compressed. The basillar part of the occipital bone beneath the tumor was noticeably atrophied. The tumor did not appear to be attached to the bone. There were no secondary tumor nodules along the spinal cord or on the surface of the brain.

There was little increase in the spinal fluid. There was apparently some bulging of the frontal bone on the right side.

Microscopically, the tumor consisted of large ovoid cells with large nuclei and well defined nuclear membranes. The nucleus was thick and dark staining mostly but a vesicular type of nucleus was also seen. The nuclei were of different sizes and a definite nucleolus was observed. Numerous mitoses were seen. The cell outlines were bizarre and the cytoplasm was acidophilic and faintly granular. These cells were arranged in pseudorosette fashion around a central mass of fibrils. Sometimes a capillary was found in the center. The cells showed vacuolation and some inclusion bodies. Holzer's stain did not reveal any neuroglial fibers. Hyaline changes in the connective tissue around the blood vessels was noticed. Blood supply was not abundant but haemorrhages were present. In one area infiltration by polymorphonuclear leucocytes was seen.

Comment. This tumor has to be distinguished from oligodendroglioma, in which the neurofibrils are seen by the silver stains; from astrocytoma which has a different type of cell altogether (i.e., a multipolar spider-like cell); from medulloepithelioma in which the cells are arranged around true canals and from ependymoma in which mitoses are fewer and the tumor does not invade the surrounding tissue.

Among dogs medulloblastoma was recorded by Milks and Olafson (154), and Neubuerger and Davis (170) and in a steer by Cordy (36).

Sundry Tumors

Melanomata. Melanomata arise from the specialised cells that produce melanin. These are the dendritic cells situated in the stratum germinativum and give a positive DOPA reaction of Bloch. The tumors have also been found to arise from the modified lemocytes of the tactile corpuscles (Foot, 72).

Melanomata, especially those of the skin are found to occur frequently among animals (222). But experience in this college is that the tumors are not so numerous as reported elsewhere, for among the 700 tumors studied and analysed here, only 23, i.e., a mere 3.3 per cent, were melanomata. The incidence and location of the melanomata received are shown in Table 12.

The cutaneous tumors are usually small in size and fairly hard to touch and on section are black in color. They bleed profusely on incision.

Microscopically, the benign tumor was very easy to diagnose as it consisted of collections of pigment laden melanoblasts amidst fibrous connective tissue. The type cell was usually polyhedral or oval. Sometimes elongated, spindle shaped forms were also seen. These cells were loaded with pigment which obscured the architecture of the cell. The nucleus was completely obscured. These cells were sometimes arranged in acinar formation. Mitotic figures were not seen.

In the malignant variety, the cells could be studied better as most of them did not contain the pigment. Here the cells were larger, polyhedral with acidophilic cytoplasm. The nucleus was very large being more than half of the cell cytoplasm, and vesicular with stippled chromatin. Two or more nucleoli were present. These cells were polymorphic and showed numerous mitotic figures. Blood vessels were very thin walled and some cells appeared to line primitive blood vessels. The stroma was plentiful. Some

Table 12. Incidence and location of melanomata among domestic animals.

Species	Number received	Location	Whether benign or malignant	
Canine	1	Subcutis	benign	
	1	"	"	
	1	"	malignant	
	1	"	"	
	1	Tongue	"	
	1	Lip	"	
	1	Tail	"	
	1	Mid dorsum of 3rd and 4th lumbar	"	
	1	Not known	"	not examined
Bovine	1	Subcutis	benign	
	1	Liver	malignant	
Equine	1	Subcutis	malignant	
	1	Tail	"	
	1	Shoulder	"	
	1	Mucous membrane	"	not examined
	1	Brain	"	not examined
Porcine	1	Sternum	malignant	
	1	Lymph gland, liver, heart, spleen	"	
	1	Skin, lymph gland	"	
	3	Unknown	malignant	- 2 of these not examined
Ovine	1	Unknown	benign	not examined
Total	23			

of the cells contained pigment.

In the metastases, these cells accumulated in clusters, producing atrophy and degeneration of the invaded tissue. In the heart the cells were found between the muscle fibers, which were fragmented. In the liver, there was nodular infiltration. In the kidney the cells had an interstitial location.

Comment. Till a few years ago the histogenesis of the melanoblast was a vexed question. There were two main schools of thought regarding its

derivation - the mesodermal and the neuroectodermal. The adherents to the former were Beattie and Dickson (8) and Cowdry (45, 46). The ectodermal theory was supported by Foot and Zeek (73), Foot (71), Laidlaw (130, 131), Jacobsen and Klinck (105) and Taylor and Tuttle (229). The latter school substantiate their theory by demonstrating exodermal elements in the melanomata arising from the naevi. Though the presence of naevi in animals (at least in horses) is denied (Jaeger, 106) the cells of some varieties of tumors as found in animals were of such histology that the tumors had to be classified as melanoepitheliomas: McFadyean (145), Caylor and Schlotthauer (31), Thomas (230) and Jackson (103).

Dawson et al. (55) consider malignant cutaneous and occular melanomata to be epithelial in origin while choroidal and meningeal melanotic cell aggregations to be of mesodermic pigment-cell type. But Strong (226) is of the view that primary melanomata of leptomeninges are of neuro-ectodermal in origin.

But recently Rawles (187) while reviewing the experimental evidence on which the 'neural crest' hypothesis is based, emphatically observed that, "the old and often heated controversy over the origin of the vertebrate pigment cell may be considered at long last to have come to an end." The opinion of Wright (238) that trauma probably plays a part in the production of malignant melanomata is still to be confirmed, though most of the workers believe that the benign melanomata sometimes, sooner or later, may get transformed into malignant variety and so radical excision of such is advocated.

Green's (81, 82) method of transplanting in the anterior chamber of guinea pig's eye is useful to diagnose amelanotic melanomata, when the tumor cells (though amelanotic in the original tumor) produce melanin.

Melanomata have been recorded in canines (13, 40, 41, 42, 88, 103, 141, 153, 166, 167, 184, 204, 234, 235), bovines (48, 88, 146, 186), equines (88, 103, 197) and porcines (103).

Embryonal Nephromata. Embryonal nephromas of domesticated animals correspond to Wilm's tumor of children. This tumor usually originates in the kidney, from pluripotent undifferentiated renal blastema, from which the adult renal tissue normally differentiates. Several names have been given to this tumor: adenoma sarcomatode, adenomyosarcoma, sarcocarcinoma, sarcoadenoma, rhabdomyoadenocarcinoma, and adenosarcoma. The last name, viz., the adenosarcoma is the most commonly used in the literature, due to the presence of epithelium-lined tubules in a solid fibroblastic tissue. "The structural variations of different tumors and of different portions of the tumor justifies the use of the term that is applicable to all tumors that arise from the elements of the primitive nephrogenic tissue, regardless of the degree of differentiation, therefore, the name embryonal nephroma seems appropriate" (Feldman, 66).

Embryonal nephromas are most frequently encountered in swine, though they have been reported in other animals. Seven tumors of this variety were received in this laboratory and their incidence is shown in Table 13.

Microscopically, the growth consisted of cellular parenchyma which was interrupted in many places by adult connective tissue containing many blood vessels. Depending on the stage of differentiation, the parenchyma exhibited different patterns of structure. The cells were mainly of two types. Firstly, the cells were spindle shaped and formed the sarcomatous moiety of the tumor. Secondly, the tubule-like structures were also formed resembling epithelial tissue. In some fields this adenomatous type of tissue predominated and in one specimen it was with difficulty that the sarcomatous elements could be

Table 13. Incidence of embryonal nephroma in domestic animals.

Species	Age	Location and description	Metastases	Symptoms, if any
Canine	Aged	Hilus of right kidney which was 6 times the size of left.	Liver	Urination interfered with.
	9 yrs.	One kidney. Tumor in sub-lumbar region weighed 740 gms., 9 × 13 × 10 cms.		Posterior paralysis.
	7 yrs.	Adjacent to a kidney, weighed 2.5 Kgs.	Pleural cavity, Liver	
	--	Kidney	----	Not examined
Equine	8 yrs.	Lumbar region, weighed 26 lbs., peritoneal cavity, with 14 qts. fluid.	Lungs, liver, diaphragm, omentum.	In poor condition, emaciated.
Porcine	--	One kidney tumor, 37.5 lbs. After removal pig weighed 64 lbs.	----	Asites.
	--	Kidney.	Liver	Packing house case.
Total	7			

distinguished. Cells lining the tubules which were irregularly arranged, projected into the lumina in a papillary fashion. Sometimes the connective tissue elements were rounded, the so called round-cell sarcoma. These had an acidophilic granular cytoplasm and a rounded slightly vesicular nucleus. Eosinophilic infiltration was noticed in two specimens.

In the metastases the above structure was repeated. In the pulmonary mestastasis of a case, there was ineffectual mimicry at glomerular formation.

Hyaline changes in the connective tissue were seen and in two instances granular casts in the still functioning renal tissue were noticed.

Comment. Striated muscle, cartilage and bone met with by others have not been seen in the cases reported here. These tumors are believed to arise from embryonic cell rests. These are always malignant, mestastases occurring in many. This tumor has been reported in canines (111, 148, 208, 233,), bovines (103, 152, 181, 232), equines (103), porcines (63, 181, 182), felines (182) and ovines (67, 103).

Canine Venereal Tumors. These tumors, principally affecting the genitalia of canines, is given different names: Transmissible lymphosarcoma, venereal granuloma, canine condyloma, venereal lymphosarcoma, infectious sarcoma and infectious lymphosarcoma. This condition has probably been imported from England through bull dogs (77).

Venereal tumors are found on the penis and prepuce, as "solitary or multiple, small or large, firm, soft or friable, gray to reddish, sessile to pedunculated, nodular, lobulated or papillary masses" (18). These are noticed on the glans and sometimes on the entire penis. In the female, this tumor is found in the vagina as a solitary or multiple nodules, which may be pedunculated or diffuse. Ulceration and degeneration is common in these tumors and there is a blood stained discharge. In fact it is this discharge that draws the attention of the owner to an abnormal condition. Sometimes these tumors may be subcutaneously situated in extragenital locations.

Thirteen tumors of this variety were received and the locations from available data are furnished below:

Testicle	1	Hip region	1
Left fore leg	1	Skin	2
Penis	1	Vagina	2

Microscopically, the histologic structure of this tumor was very characteristic. The sections revealed a very cellular tumor comprising of cells, uniform in size and shape. The cells were round to polyhedral, having

a finely granular cytoplasm which was acidophilic with hemotoxylin and eosin stain. Rarely a basophilic cytoplasm was met with. In some instances, the cytoplasm was also neutral. The nucleus was relatively large, round and placed centrally. Numerous mitoses were seen. A fine vascularised connective tissue stroma was present.

Comment. The most noteworthy feature of this tumor is its infectious nature, infection being by way of coitus. It can be transmitted very easily from one animal to another (115). For successful transmission living cells are required as cell-free filtrates are not potent in setting up the disease (227).

Agreement has not been reached regarding the histogenesis of the neoplasm. Feldman (66) is inclined to suggest that this tumor is derived from 'undifferentiated cells of lymphoid series'. Jackson (104) favours the view that the cells are carcinomatous, while Mulligan (166) considers it a histiocytoma. Bloom et al. (20) utilizing transmission, morphologic, cytologic, histochemical and tissue culture studies have concluded that the tumor cell is a mature end cell of the reticulo-endothelial origin. They suggest the retention of the name 'transmissible venereal tumor'.

While on the subject of venereal tumors, it may be pertinent to refer to the so-called heart base tumors. These, Jackson (103) contends, on the weight of the similarity in histologic structure, to be venereal sarcomata. But Bloom (14) after an exhaustive study concludes that it is an aortic body tumor. This view is shared by Nilsson (176), and Riser and Bailey (193). Tumors similar to those of the aortic body were found in the carotid bodies of dogs by Scoti (216).

Venereal tumors among canines were reported by many authors (40, 41, 103, 129, 139, 166, 202, 205).

SUMMARY AND CONCLUSIONS

In Table 14 are listed, according to their structure and species of animals in which they were found, the 700 neoplasms received in this laboratory. It will be noticed that the tumors are divided into two categories: A, those for which slides or blocks were available and so studied in detail, B, those which were not examined but the diagnosis for which was taken from the records. C, denotes Total.

In general: Papillomata among all animals were 21, i.e., three per cent of the total number of neoplasms and 7.3 per cent of the neoplasms of epithelial origin.

Benign epithelial tumors, other than papillomata, were 17 and all were found in dogs except the two parotid tumors which were in equines.

Malignant epithelial tumors were 249, i.e., 35.5 per cent of all neoplasms or 87.4 per cent of all epithelial tumors.

Eighty eight benign tumors of the non-hemopoietic mesenchymal tissues accounted for 12.6 per cent of all the tumors received and 42.5 per cent of all of the non-hemopoietic mesenchymal tumors.

The malignant non-hemopoietic mesenchymal tumors were 117, i.e., 16.6 per cent of the total number or 57.5 per cent of all tumors of the non-hemopoietic mesenchymal tissues.

Tumors of the hemopoietic tissues received were 164 or 23.4 per cent of the total number of neoplasms analysed.

Canine Neoplasms

Two hundred ninety one neoplasms were received, i.e., 41.5 per cent of the total number of 700. Of these, 130 (44.7%) were of epithelial origin.

Table 14. List of neoplasms obtained from different species of animals.

Types of tumors	Canines			Bovines			Equines			Porcines			Felines			Ovines			Total
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
Tumors of the Epithelial Tissues																			
Bénign																			
Papilloma	3	5	8	6	3	9	1	2	3	-	-	-	1	1	-	-	-		21
Adenomata																			
Adrenal cortex	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-		1
Rectal mucosa	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-		2
Anal glands	4	1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-		5
Sweat glands	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-		1
Sebacious gland	1	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-		3
Mammary gland	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-		3
Mixed tumor of parotid	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-		2
Total	14	9	23	6	3	9	1	4	5	-	-	-	1	1	-	-	-		38
Malignant (carcinomata)																			
Prostate	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-		2
Pancreas	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-		3

Table 14. (cont'd)

Types of tumors	Canines			Bovines			Equines			Porcines			Felines			Ovines			Total
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
Sweat gland	4	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Sebacious gland	-	1	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	2
Gastro-intestinal gland	2	1	3	-	-	-	-	1	1	-	-	-	1	3	4	-	2	2	10
Anal glands	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Hair matrix	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Basal cell	1	2	3	-	-	-	-	1	1	-	-	-	2	1	3	-	-	-	7
Hepato-cellular	1	2	3	3	-	3	-	-	-	1	-	1	-	-	-	-	-	-	7
Cholangio-cellular	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Pulmonary	1	-	1	1	1	2	-	-	-	-	-	-	1	-	1	-	-	-	4
Mammary	16	19	35	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	36
Urachus	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Squamous-cell	14	26	40	17	59	76	14	24	38	-	1	1	-	-	-	1	-	1	156
Transitional cell	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1

Table 14. (cont'd)

Types of tumors	Canines			Bovines			Equines			Porcines			Felines			Ovines			Total
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
Thymoma	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Adamantinoma	2	-	2	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	3
Granulosa cell	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Thyroid	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Seminoma	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Sertoli-cell	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Total	53	54	107	23	60	83	19	26	45	1	1	2	5	4	9	1	2	3	240
Tumors of Non-Hemopoietic Mesenchymal Tissues																			
Benign																			
Fibroma	1	1	2	3	5	8	1	16	17	-	-	-	-	-	-	-	-	-	27
Keloid	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Nasal-polyp	-	-	-	-	-	-	3	3	6	-	-	-	-	-	-	-	-	-	6
Myxoma	-	2	2	-	2	2	-	1	1	-	-	-	-	-	-	-	-	-	5
Lipoma	1	14	15	1	3	4	1	-	1	-	-	-	-	-	-	-	-	-	20
Chondroma	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	4
Osteoma	-	-	-	-	-	-	1	4	5	-	-	-	-	-	-	-	-	-	5

Table 14. (cont'd)

Types of tumors	Canines			Bovines			Equines			Porcines			Felines			Ovines			Total
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
Leiomyoma	1	-	1	1	1	2	2	-	2	-	1	1	-	-	-	-	-	-	6
Rhabdomyoma	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Fibro-chondroma	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Fibrolipoma	-	1	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	2
Osteofibroma	-	-	-	1	-	1	-	1	1	-	-	-	-	-	-	-	-	-	2
Angioma	2	1	3	-	1	1	1	-	1	1	-	1	-	-	-	-	-	-	6
Neurofibroma	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Total	7	21	28	6	12	18	12	25	37	1	2	3	-	-	-	-	-	-	88
Malignant (sarcomata)																			
Fibrosarcoma	13	16	29	2	5	7	3	32	35	-	-	-	-	-	-	-	-	-	71
Sarcoid	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Myxosarcoma	-	-	-	-	-	-	1	1	2	-	-	-	-	-	-	-	-	-	2
Chondrosarcoma	-	-	-	1	-	1	-	1	1	-	-	-	-	-	-	-	-	-	2
Osteosarcoma	7	1	8	1	-	1	-	4	4	-	-	-	-	-	-	-	-	-	13
Osteoclastoma	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Leiomyosarcoma	1	1	2	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	4

Table 14. (cont'd)

Types of tumors	Canines			Bovines			Equines			Porcines			Felines			Ovines			Total
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
Angiosarcoma	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1
Pericytoma	4	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Mesothelioma	-	-	-	-	-	-	1	2	3	-	-	-	-	-	-	-	-	-	3
Mastocytoma	15	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Total	41	18	59	5	5	10	7	40	47	-	-	-	-	-	-	1	-	1	117
Tumors of Hemopoietic Tissues																			
Lymphocytoma	33	11	44	24	46	70	2	4	6	11	11	22	4	-	4	1	2	3	149
Myelocytoma	3	1	4	7	2	9	-	-	-	1	-	1	-	-	-	-	-	-	14
Hodgkin's disease	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	1
Total	36	12	48	31	48	79	2	4	6	13	11	24	4	-	4	1	2	3	164
Tumors of Neural Tissues																			
Schwannoma	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Medullo-blastoma	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Total	1	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2

Table 14. (Conc'l)

Types of tumors	Canines			Bovines			Equines			Porcines			Felines			Ovines			Total
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
Sundry Tumors																			
Melanomata																			
Benign	2	-	2	1	-	1	-	-	-	-	-	-	-	-	-	-	1	1	4
Malignant	6	1	7	1	-	1	3	2	5	4	2	6	-	-	-	-	-	-	19
Embryonal-nephroma	3	1	4	-	-	-	1	-	1	2	-	2	-	-	-	-	-	-	7
Venereal tumor	12	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
Total	23	2	25	2	-	2	4	2	6	6	2	8	-	-	-	-	1	1	42
Grand total	175	116	291	74	128	202	45	101	146	21	16	37	9	5	14	4	6	10	700

Among the epithelial tumors, 23 (17.7%) were benign and the rest malignant.

Among the malignant epithelial neoplasms, the mammary tumors occurred 35 times (34.8%). This figure is in agreement with Krook's (126).

Non-hemopoietic mesenchymal tumors were 87, i.e., 30 per cent of all tumors received. Of these, 33 per cent were benign. Among the benign tumors, lipomata were the largest number. Among the malignant tumors, fibrosarcomata have the highest incidence. Mastocytoma was the tumor with the next highest incidence.

Tumors of the hemopoietic tissues are nearly 16 per cent of the total and among these the majority were lyphocytomata.

Venereal tumors accounted for four per cent of canine tumors, which is about equal to the figures of Mulligan (166).

Of particular interest was the description, for the first time in this laboratory, of the following tumors from dogs: adamantinoma, pericytoma and sertoli-cell tumor.

Bovine Neoplasms

Two hundred two bovine tumors were received, i.e., 29 per cent of all the tumors. Of these, 92 (46%) were of epithelial origin. Eighty three of these epithelial tumors were malignant. A majority of the malignant tumors were squamous-cell carcinomata and among these, 58 were found in the eye.

Tumors affecting the non-hemopoietic mesenchymal tissues were 28. Of these 18 were benign. Fibromata were the most common of the benign neoplasms. Fibrosarcomata occurred more frequently among the malignant tumors.

Seventy nine tumors of the hemopoietic tissues, i.e., 39 per cent of bovine tumors, were received, of which lyphocytomata were 70 and were the

most frequent of the bovine tumors.

Of special interest was the description of the following bovine tumors, for the first time in this laboratory: cholangiocellular carcinoma, a primary pulmonary carcinoma and a schwannoma.

Equine Neoplasms

One hundred forty six, i.e., 21 per cent of all tumors were found in equines. Of these 50 (34.3%) were of epithelial origin. Forty five of the epithelial tumors, i.e., 90 per cent were malignant. In the equines also, the squamous-cell carcinoma was the most frequent malignant epithelial tumor and among these the cancer of the eye occurred most often.

Eighty four (57.5% of equine tumors) neoplasms of the non-hemopoietic mesenchymal tissues were received, of which 37 (44%) were benign. Fibromata (17 in number) were the most common among the benign while fibrosarcomata (35 in number) were the most common of the malignant tumors.

Of special interest was the diagnosis, for the first time, of the following equine tumors in this laboratory: thymoma, adamantinoma and sarcoid.

Porcine Neoplasms

Thirty seven porcine tumors, i.e., 5.3 per cent of the total number of tumors were obtained of which two were of epithelial origin, three were from non-hemopoietic mesenchymal tissues and 24, (i.e., 65 per cent of the porcine tumors) were of hemopoietic tissues in origin, six were melanomata and two embryonal nephromata. The lyphocytoma was the most common porcine tumor studied. Next in frequency of occurrence were the melanomata. Hodgkin's disease or a condition resembling it found now was not described

here previously.

Feline Neoplasms

Fourteen tumors from cats, i.e., two per cent of the total number were obtained from cats. Of these, 10 were of epithelial in origin and four were lyphocytomata. Adenocarcinoma was found in four cases and basal cell carcinoma in three. One primary bronchigenic carcinoma described now was not found in this laboratory previously.

Ovine Neoplasms

Only 10 tumors were obtained from sheep, of which two were carcinomata of the intestines, one a squamous-cell carcinoma of the eye, two were chondromata, one a leiomyosarcoma, three lyphocytomata and one melanoma. Literature regarding ovine tumors is rare. Jackson (103) has described 39 ovine neoplasms.

Multiple Neoplasms

One case of multiple neoplasm in a dog was found, viz., a leiomyosarcoma of the head and an adenocarcinoma of the mammary gland. Instances of such multiple tumors have been recorded among dogs (27, 60, 62, 162, 218) and a cow (24), but are considered rare.

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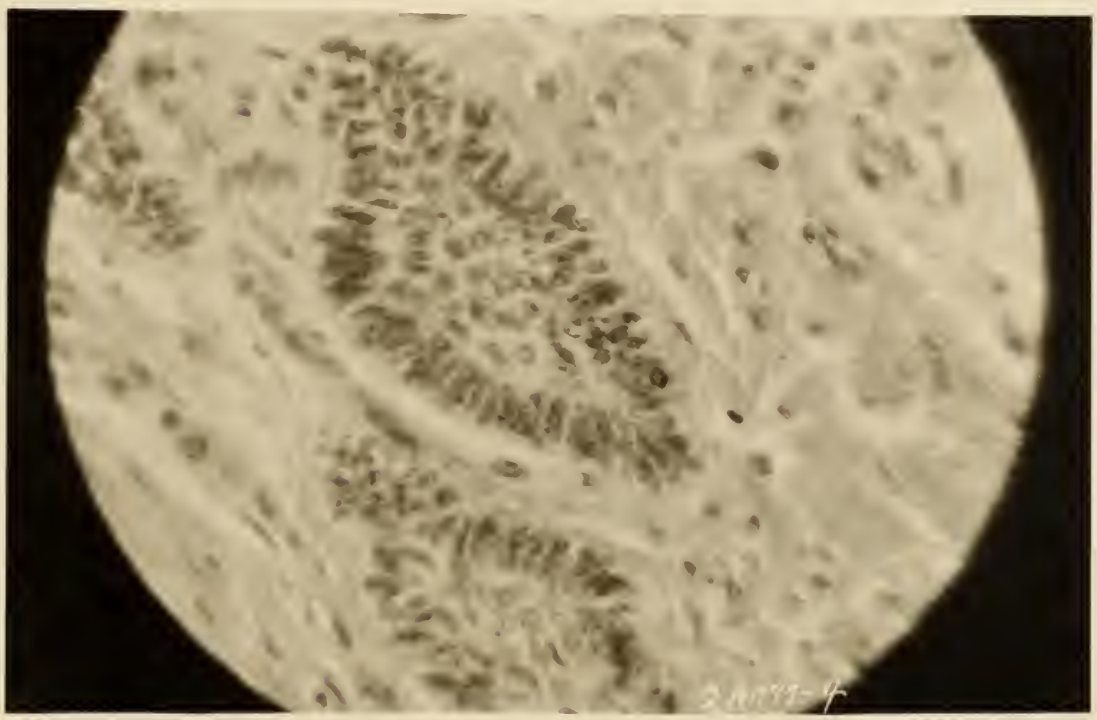
APPENDIX

Explanation of Plate I

Section of an adamantinoma found to arise from the mandible of an old mule. The higher magnification reveals the characteristic columnar cells with elliptical nuclei arranged in alveolar formation. The serrated edge on the external side of the alveolus, referred to on page 30, is clearly demonstrated. A X 200; B X 500.

Plate I

A

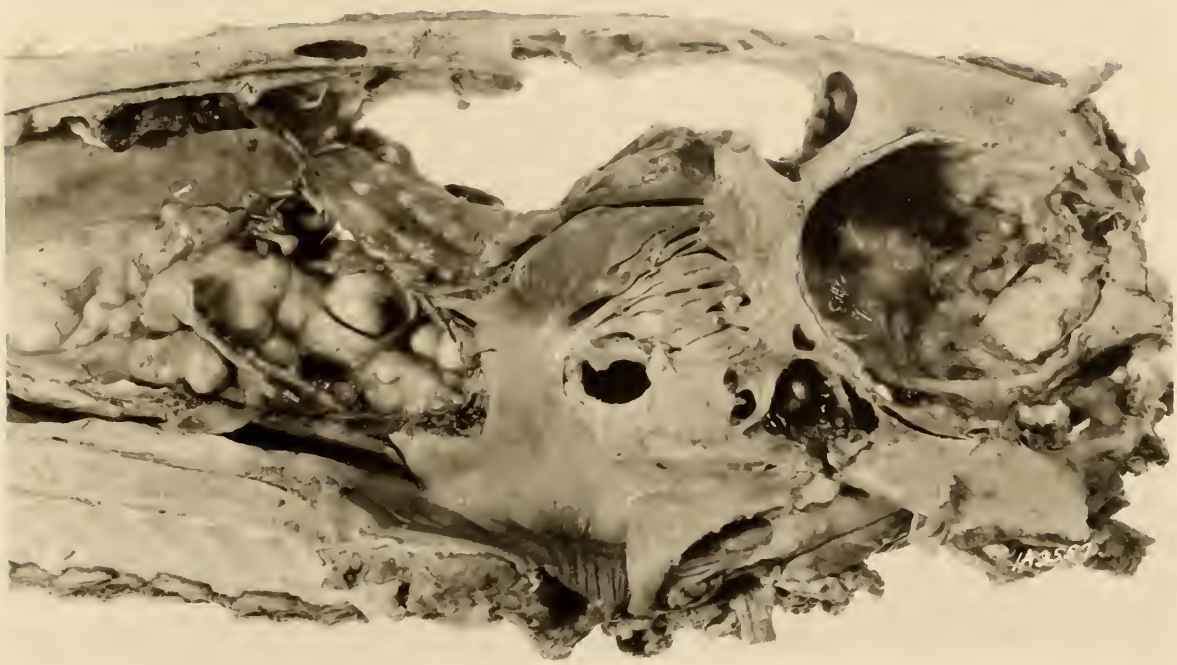


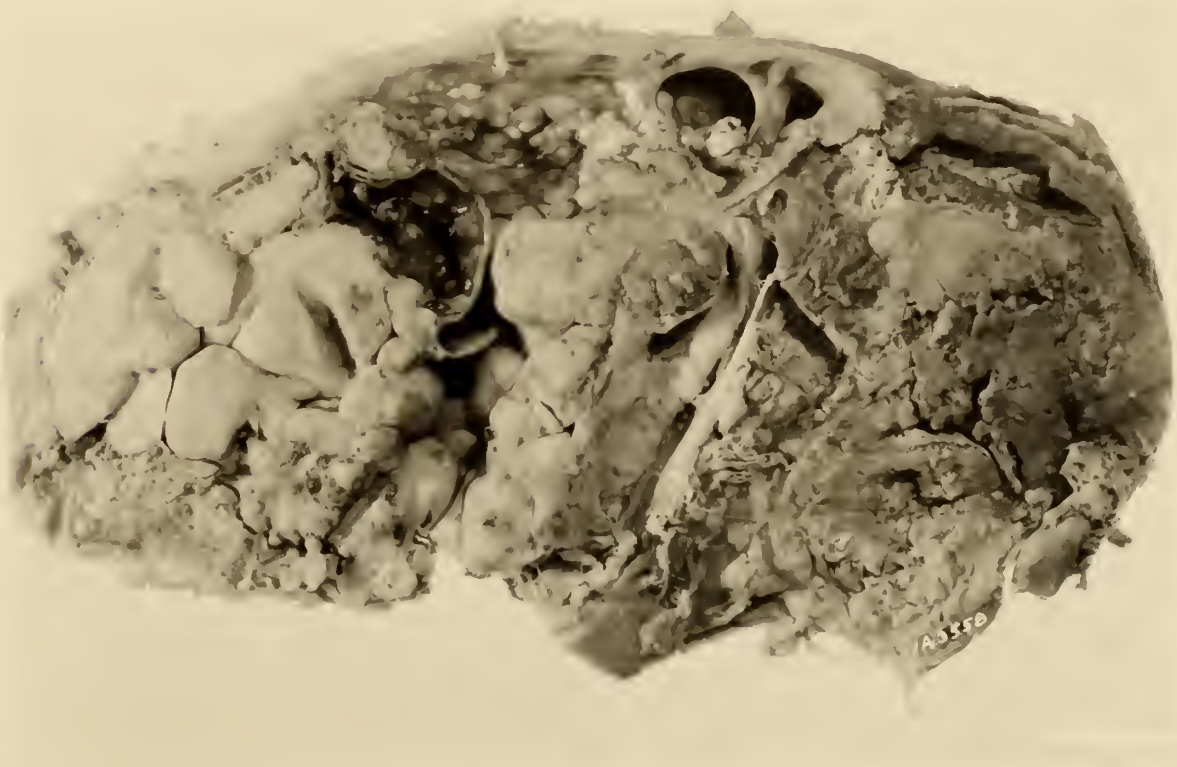
B

Explanation of Plate II

This shows metastatic nodules of the carcinoma of the eye in the frontal and maxillary sinuses of an eight year old horse.

Plate II



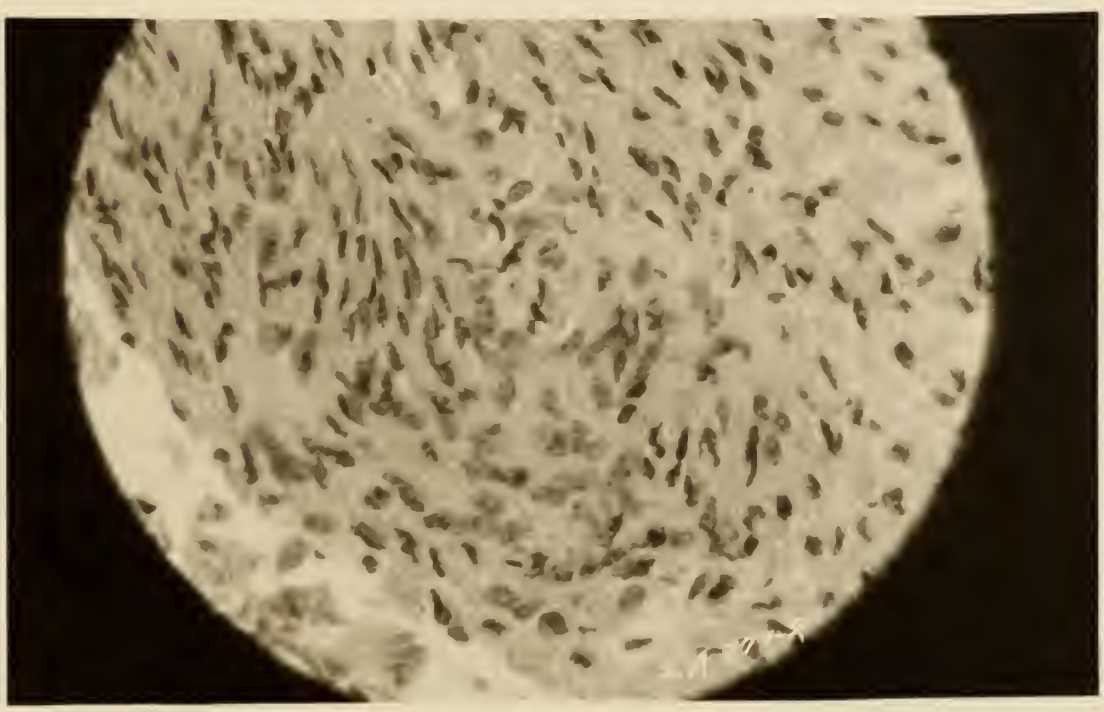


Explanation of Plate III

Section of a neurofibroma. A (X 200) shows an encapsulated 'nodule' and B (X 500) shows the whorled arrangement of the spindle cells, referred to on page 40.

Plate III

A



B

Explanation of Plate IV

This is an osteoma, growing from the interdental space of a horse. It measured 8 × 9 × 7 cms.

Plate IV

Explanation of Plate V

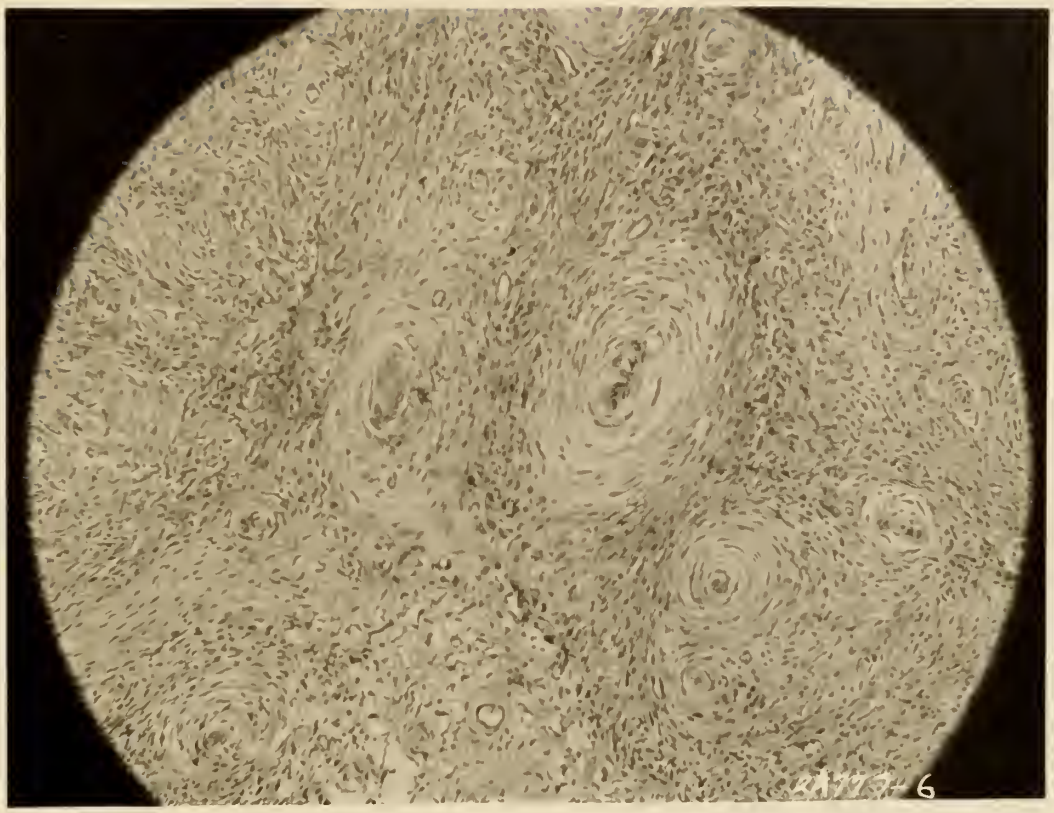
This is an osteofibroma arising from the anterior surface of the mandible of a Texas steer. It measured 8 1/2 × 6 × 5 inches and weighed 3850 gms.

Plate V

Explanation of Plate VI

Section of a hemangiopericytoma showing the characteristic 'finger print' arrangement. (X 200)

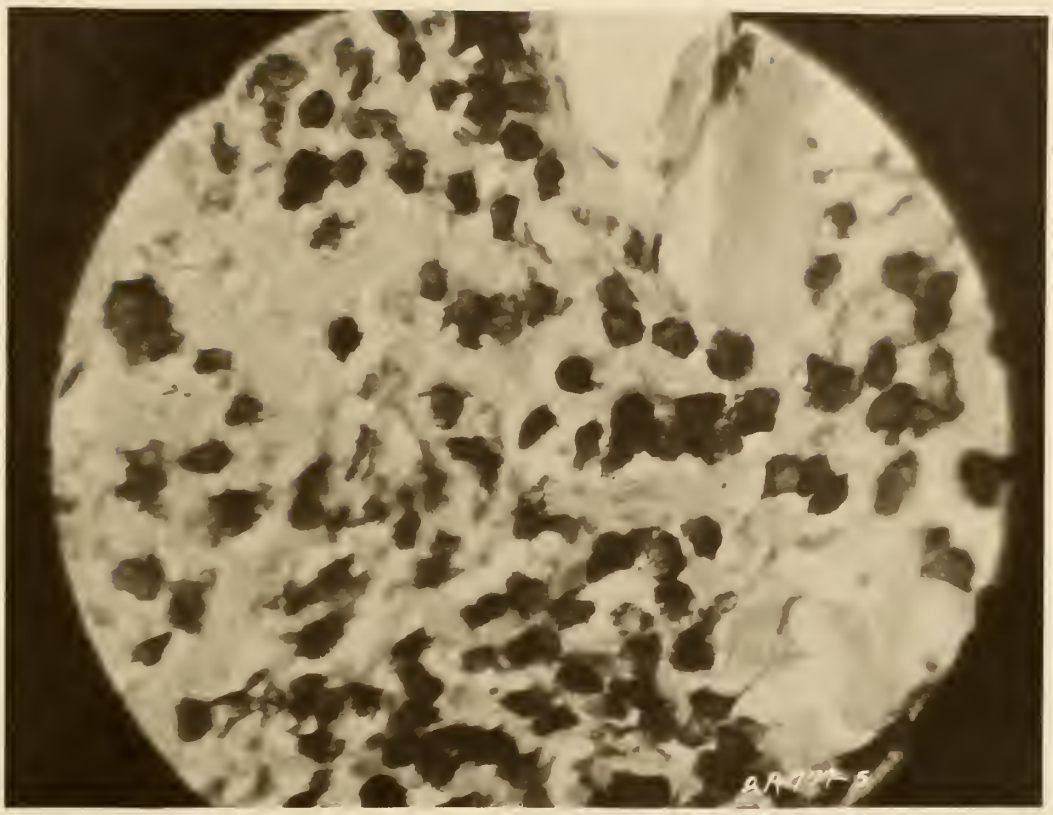
Plate VI



Explanation of Plate VII

Section of a mastocytoma showing the granule-laden mast cells, stained black. (X 500).

Plate VII



Explanation of Plate VIII

Lymphocytoma. This shows the lung of a 5 year old cow, containing numerous nodules.

Plate VIII

Explanation of Plate IX

Lymphocytoma. This picture shows the viscera of a hog studded with numerous neoplastic nodules of various sizes.

Plate IX

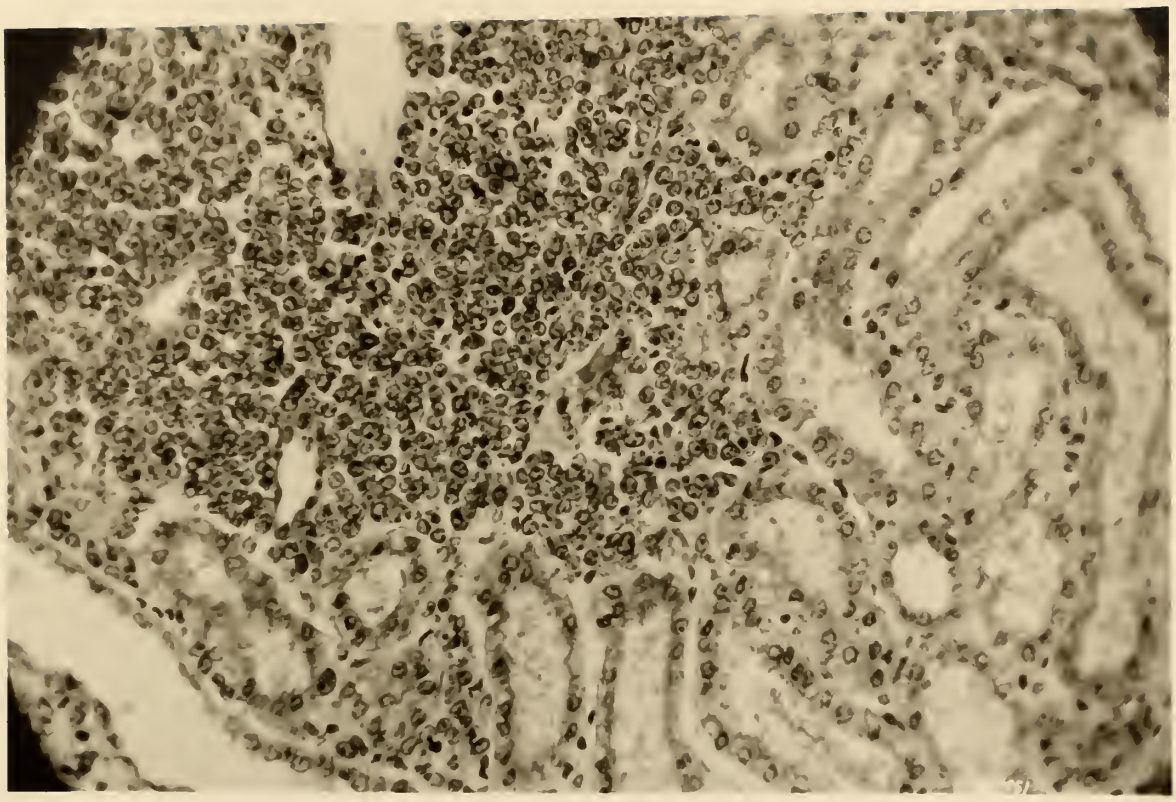
Explanation of Plate X

Lymphocytoma.

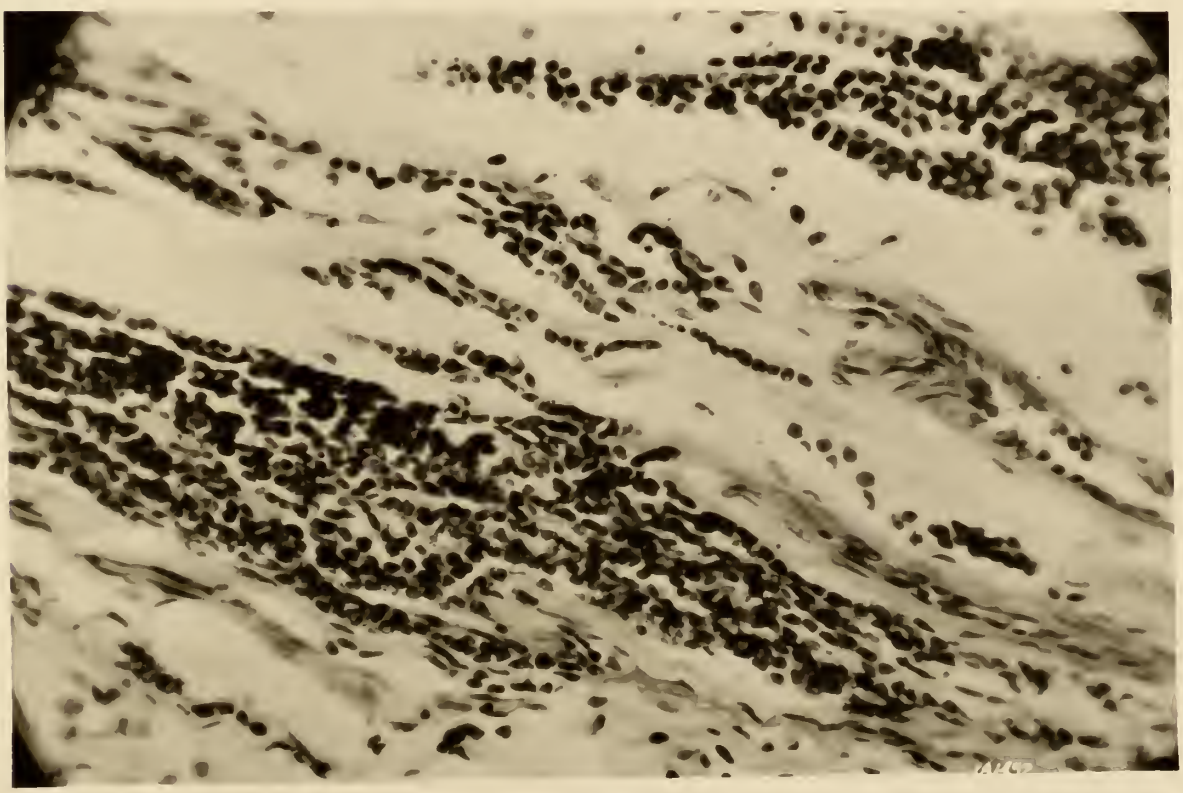
A. Section of a porcine kidney showing nodular infiltration by immature lymphocytes. (X 500).

B. Section of the bladder of the above pig showing lymphocytic infiltration of the musculature of the urinary bladder. (X 500).

Plate X



A



B

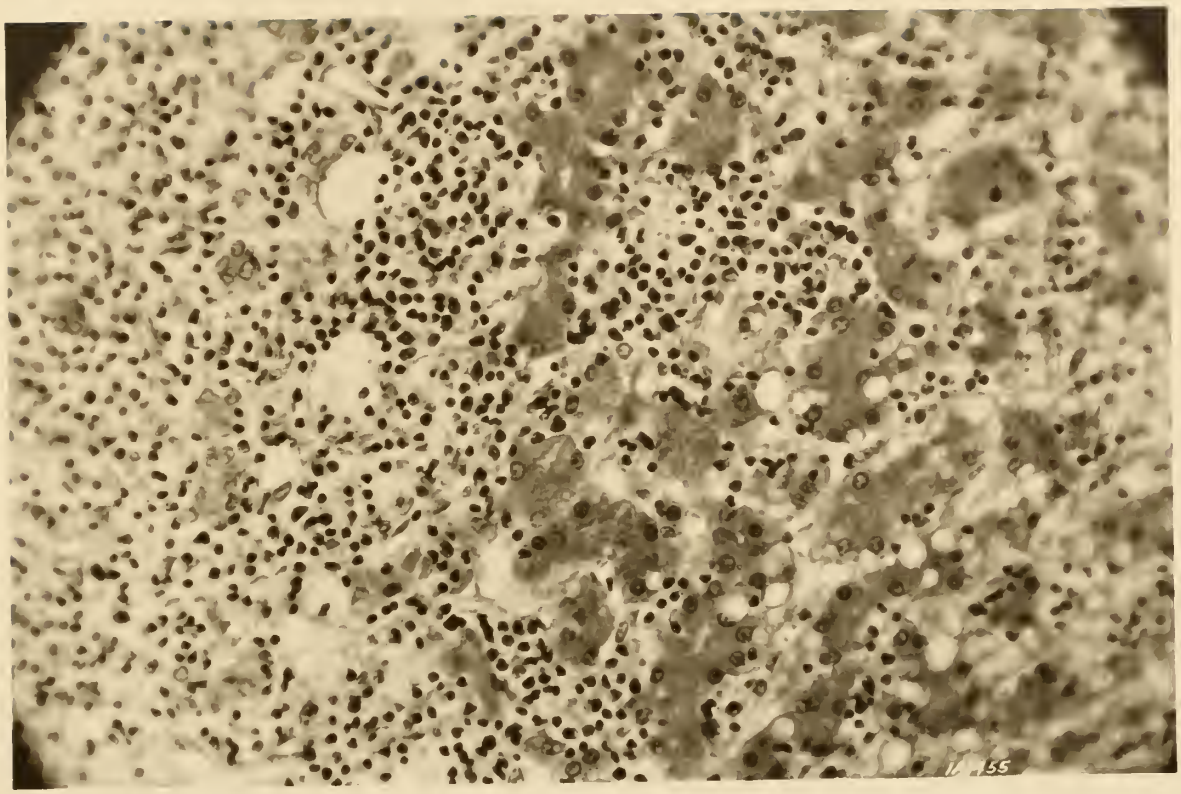
Explanation of Plate XI

Lymphocytoma:

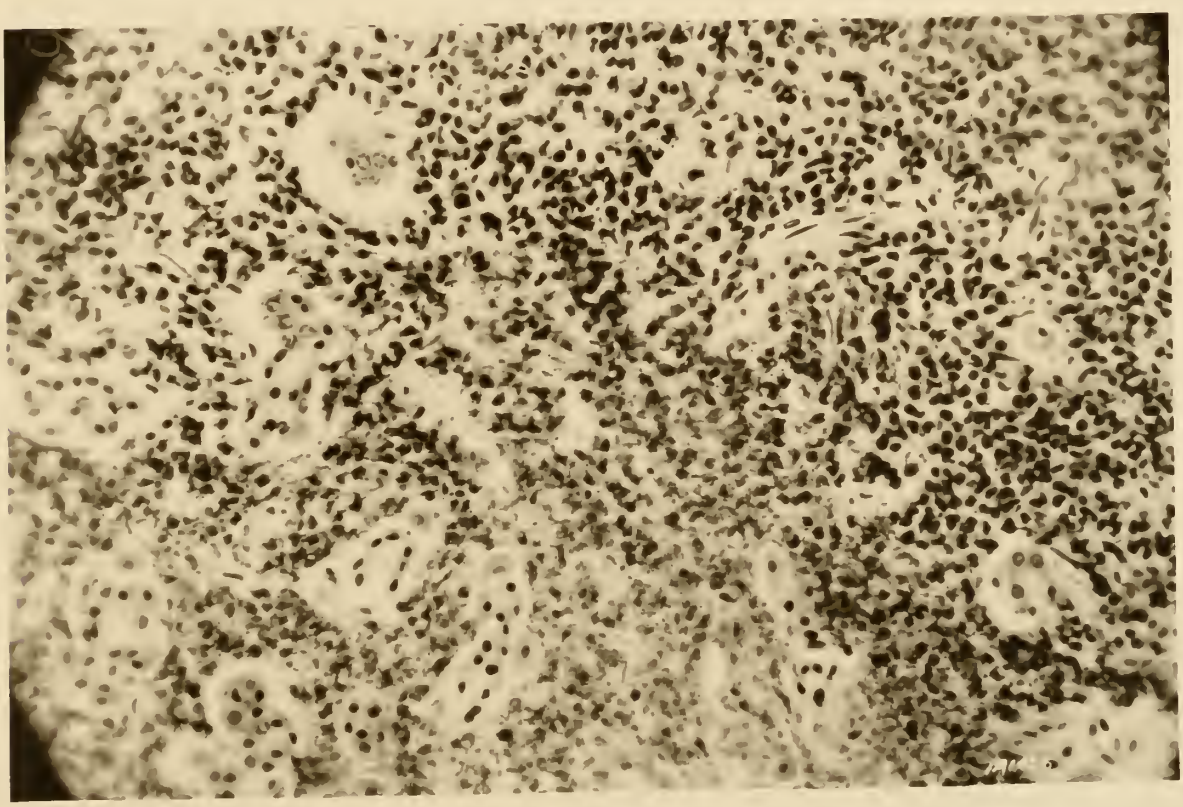
A. Section of the liver of a mule showing the replacement of the parenchyma by the neoplastic lyphoid cells. The hepatic cells reveal different stages of degeneration. (X 500).

B. Section of a bovine stomach showing the infiltration and gradual replacement of the glandular tissue of the stomach. The infiltration extends also into the muscular coat. (X 500).

Plate XI



A



B

A SURVEY OF ANIMAL NEOPLASMS

by

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B. V. Sc., Madras University, India, 1940
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AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Pathology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1959

This survey was made with a view to study the relative frequency in the incidence of different types of neoplasms among the domesticated animals in the Kansas State. Seven hundred tumors were available for this purpose. These tumors were submitted to this laboratory for diagnosis from the College clinic, by the practicing veterinarians and by the Inspectors in the packing houses.

Detailed histopathological studies for 328 neoplasms were made, for which slides and or blocks were available. For the rest of the tumors, records were available for classification.

Of the tumors studied, 291 (41.5%) were canine, 202 (29%) were bovine, 146 (21%) were equine, 14 (2%) were feline and 10 (1.4%) were ovine in origin.

Canine Tumors. Among the canine tumors, 130 (54.8%) were epithelial in origin. Among these, 23 were benign and the rest malignant. Tumors of the mammary gland, which were 38, were the most common canine epithelial tumors affecting a single organ. Other tumors studied were: one from adrenal cortex, eight of the perianal glands, five from the sweat glands, four of the sebacious glands, two from the prostate, three from the pancreas, one of the lung, three of the liver, five from the hair matrix, one from the urachus, 40 from the integument of various places, four from the testis, two from the teeth, and five from the intestinal mucosa.

Eighty seven tumors arose from the non-hemopoietic mesenchymal tissues. Of these, 33 per cent were benign. Among the benign, lipomata, numbering 15 were the most frequent. Among the malignant, fibrosarcomata, which were 29, were more common. Other types of tumors met with were: two fibrochondromata, one fibrolipoma, two myxomata, two chondromata, eight osteosarcomata, one osteoclastoma, three leiomyoblastomata, three angiomata, four hemangiopericytomata and 15 mastocytomata.

Tumors of the hemopoietic tissues were nearly 16 per cent of the total canine neoplasms, and of these the majority were lymphocytomata, viz., 44. Four cases of myeloid leukemia were also studied.

Other tumors studied were: one medulloblastoma, two benign and seven malignant melanomata, four embryonal nephromata and 12 venereal tumors.

The following tumors have not been previously described in this laboratory: adamantinoma, sertoli-cell tumor and pericytoma.

Bovine Tumors. Among the bovine tumors, 92 (46%) were epithelial in origin, of which 83 were malignant. Majority of the malignant neoplasms (76) were squamous-cell carcinomata and of these 58 were found to arise from the eye. Other epithelial tumors studied were: nine papillomata, two primary lung tumors, three hepatocellular carcinomata, one cholangiocellular carcinoma, and one granulosa-cell tumor.

Twenty eight tumors were found to affect the non-hemopoietic mesenchymal tissues. Of these, 18 were benign, of which eight were fibromata. Of the 10 malignant tumors, seven were fibrosarcomata. Other types of tumors in this category studied were: four lipomata, two myxomata, three leiomyoblastomata, one chondrosarcoma, one osteosarcoma, one osteofibroma, and one angioma.

Seventy nine tumors of the hemopoietic tissues (39%) were studied, of which 70 were lyphocytomata. Nine cases of myeloid leukemia were also examined.

A schwannoma, a benign and a malignant melanoma were other types of tumors received.

Cholangiocellular carcinoma, primary pulmonary carcinoma and schwannoma were not studied in this laboratory previously.

Equine Tumors. Of the 50 epithelial tumors of the equines, 45 (90%) were malignant. In this species also, the squamous-cell carcinoma was the most frequent malignant epithelial tumor and among these the cancer of the eye occurred most often. Other epithelial tumors received were: a gastric carcinoma, three papillomata, two mixed tumors of the parotid gland, a basal cell carcinoma, a transitional cell carcinoma, a thymoma, an adamantinoma, an adenocarcinoma of the thyroid, and an adenocarcinoma of the stomach.

Eighty four (57.5%) non-hemopoietic mesenchymal tumors were obtained of which 37 were benign. Fibromata (17) were the most common among the benign tumors and the fibrosarcomata (35) among the malignant. Other connective tissue tumors received were: one keloid, three myxoblastomata, one sarcoid, six nasal polyps, nine osteoblastomata, one chondrosarcoma, two leiomyomata, one rhabdomyoma, one osteofibroma, two angioblastomata, one neurofibroma, and three mesotheliomata.

Besides the above tumors, six lymphocytomata, six malignant melanomata and one embryonal nephroma were also examined.

The following tumors were described for the first time among the collection of this laboratory: thymoma, adamantinoma and sarcoid. The thymoma described appears to be the third of its kind in this species reported so far.

Porcine Tumors. Of the porcine tumors, two were of epithelial tissues in origin. One of these was a hepatocellular carcinoma and the other a squamous-cell carcinoma.

The three benign connective tissue tumors were: a leiomyoma, a fibrolipoma and an angioma.

Twenty four (65%) tumors of the hemopoietic tissues were studied of which the lymphocytomata i.e., 22 were the most common. One myeloid leukemia and one case of a Hodgkin's disease-like condition were the rest of the

hemopoietic tissue tumors.

Other types of tumors obtained were: six malignant melanomata and two embryonal nephromata.

Hodgkin's disease or a condition closely resembling it was noticed in this laboratory now for the first time.

Feline Tumors. Ten of the 14 feline tumors were epithelial in origin, which were a papilloma, a sebacious gland carcinoma, four adenocarcinomata of the intestines, a primary bronchiogenic carcinoma and three basal-cell carcinomata.

Four lymphocytomata were the only other type of tumors seen.

The primary bronchiogenic carcinoma was not described in this laboratory previously.

Ovine Tumors. The ovine tumors received were: two adenocarcinomata of the intestines, one squamous-cell carcinoma, two chondromata, one leiomyosarcoma, three lymphocytomata and one melanoma.

One case of multiple neoplasia in a dog was studied, viz., a leiomyosarcoma of the head and an adenocarcinoma of the mammary gland.